Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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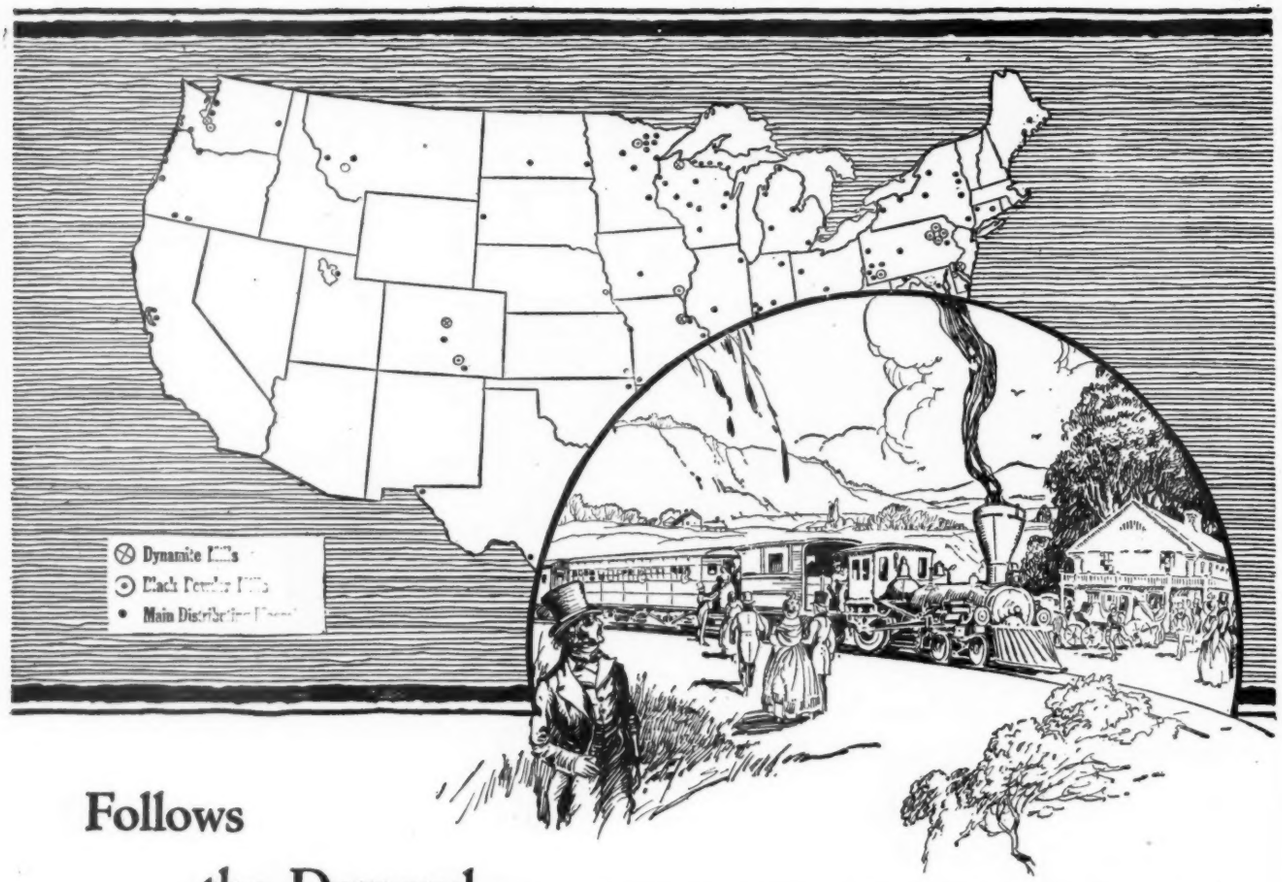

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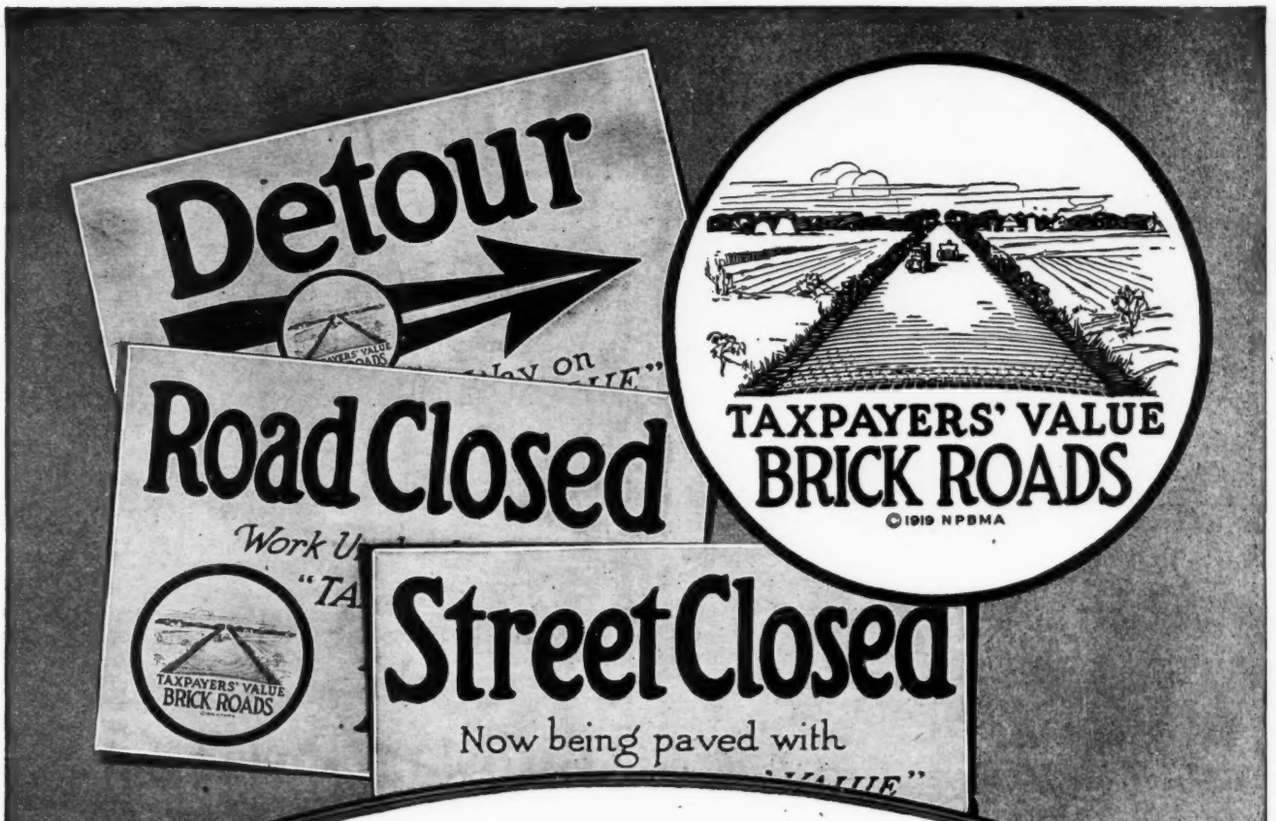

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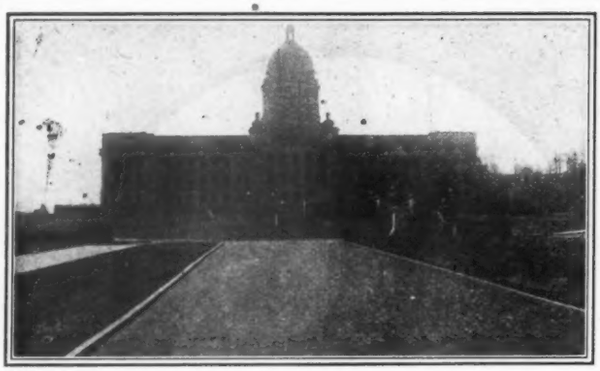

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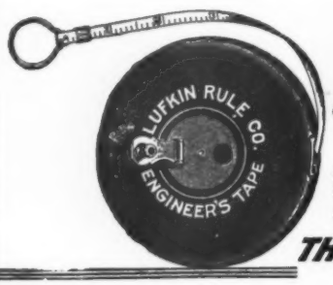

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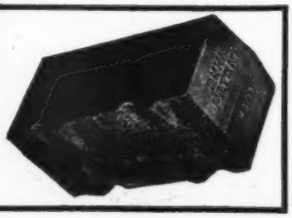

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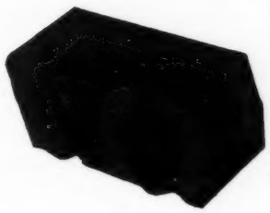

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Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Crane Co.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Gravel Screener and Loader.
The Jordan & Steele Mfg. Co., Inc.
Good Roads Machinery Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger

Hoists, Electric.
Pawling and Harnischfeger.

Hoists—Motor Truck.
Columbian Steel Tank Co.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

METROPOLITAN

The Largest Makers of Paving Brick in the World

HOW TO UTILIZE AN OLD ROAD

Here is a photograph of as fine a road as one could want to see. It is paved with "Bessemer" paving brick (block).

Not long ago this was a macadam road which proved hopelessly inadequate to the traffic requirements.

Taking advantage of the unsurpassed quality and service which the operation of seven modern paving brick plants enables Metropolitan to give, this brick pavement was laid, using the old macadam as a foundation. A road which would soon have been a dead loss to the community was thus transformed into a beautiful, clean, smooth highway, which will last, as good brick roads do, for *decade upon decade*—and with minimum maintenance cost.

Hundreds of miles of old macadam roads have been similarly utilized—and thousands more should be. Can we be of assistance? Please write.

METROPOLITAN PAVING BRICK COMPANY
Canton, Ohio

Photo shows Boardman Road, near Youngstown, Ohio. Paved with "Bessemer Block"—a Metropolitan product.

BUYERS' GUIDE

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L. The.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
Harris Air Pump Company.
Smith Co., T. L., The.

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Vitrified Pipe Mfrs. Assn.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
Crane Co.
Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
Philip Carey Co., The.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith
Walter H. Flood
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Valves.
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.
McNutt Meter Box Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Winches, Vertical Capstan or Friction Drum.
Mead-Morrison Manufacturing Co.

Wire Rope.
American Steel & Wire Company

Windows (Steel).
Truscon Steel Co.

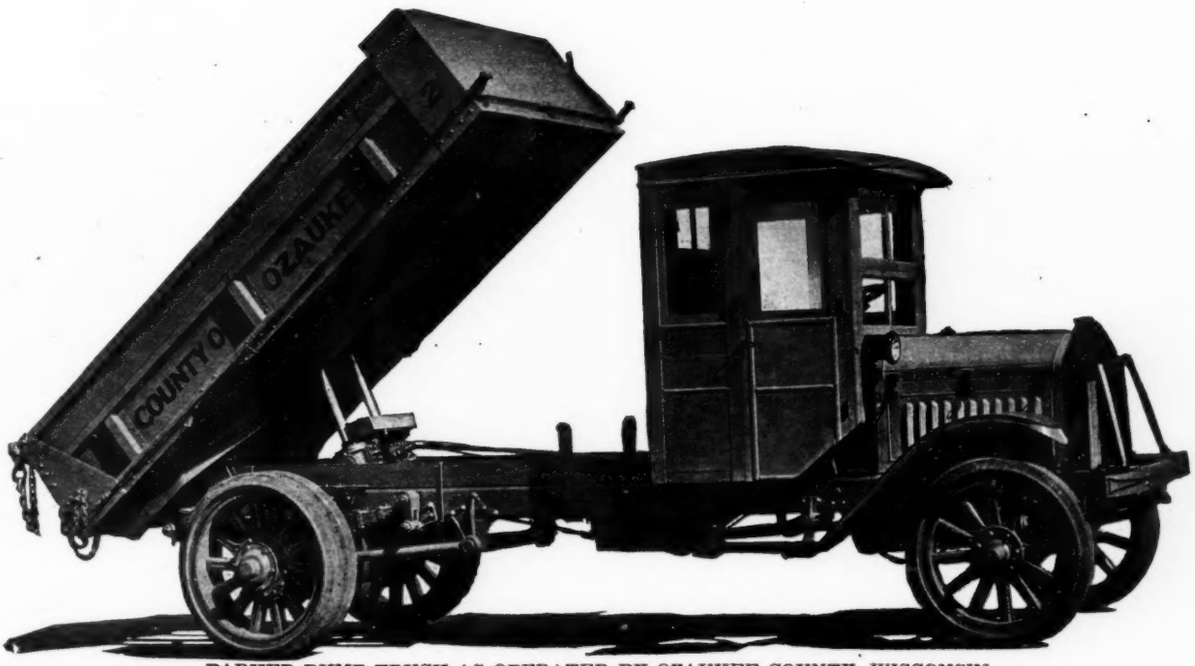
Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



PARKER DUMP TRUCK AS OPERATED BY OZAUKEE COUNTY, WISCONSIN.

Printed as insert to Municipal and County Engineering, Chicago, Ill., May, 1920.

MOTOR TRUCK OPERATION AND ACCOUNTING LVII

Tinted Paper Temporarily Discontinued in This Section

Conditions in the paper manufacturing industry, with which the readers and patrons of Municipal and County Engineering are familiar, have made necessary the temporary discontinuance of the use of the heavy tinted stock on which this Motor Truck Section has been printed for nearly five years. The publishers of this magazine have generously borne several great price increases on the colored stock, without passing the cost on to advertisers and subscribers in the form of increased rates. But now the tinted stock can hardly be secured at any price and deliveries are in the last degree uncertain, so the publishers are compelled, for the time being, to drop the tinted stock and use the same high quality of white paper in this section which is employed in the other departments of the magazine. Undoubtedly patrons of the magazine will realize that the publishers have great manufacturing difficulties with which to contend in these times.

Performance of a White Truck in Decatur County, Iowa

Mr. Frank G. Mallette, of Leon, Iowa, County Engineer of Decatur County, has contributed the following data on the performance of a White truck in the service of the county:

Decatur County at the present time is using three 2-ton and one 1-ton White trucks. The former are equipped with pneumatics in front and solids behind and the latter has pneumatics all around. Following is a sample itemized cost sheet and is for the 2-ton White truck with engine No. 30234-G.K.

Initial cost: (June 15th, 1919.)		
Chassis complete	$3,530.60	
Cab and body	171.55	$3,702.16
2 pneumatics (Guar. 8,000 miles)	153.50	
2 solids, 36 ins.x7ins. (Guar. 7,000 miles)	130.14	283.64
Total cost minus tires		$3,418.52
Fixed charges:		
6% int. on $3,418.52	$ 111.10	
Insurance (none)		
Operating charges:		
Wages, driver	$ 784.38	
Gasoline (1,023 gals.)	261.55	
Oil (425 qts.)	75.38	
Grease, waste etc	15.17	
Tires (1 set pneumatic)	153.50	
Tires (pneumatics 2nd set 1,760 miles)	33.79	
Solid tires (ran 6,364 miles)	118.37	
Repairs and renewals	18.94	
Storage	12.00	
Depreciation (75,000 - mile basis)	289.56	
Total		$1,762.64
Total fixed charges	$ 111.10	
Total operating charges	1,762.64	
Total charges		$1,873.74
Cost per day to operate (143 days)	$ 13.10	
Cost per ton mile (6,364)	.294	
Miles per gal. of gas	6.22	
Miles per qt. of oil	15.00	

The 2-ton size has been adopted for our work because of the fact that our hauling is all done over earth roads during all seasons of the year, and it is thought better economy to make more trips carrying less weight than to use a heavier class of trucks. As a comparison with team hauling under the same conditions the following is true: Teams including driver at rate of 75 cts. per hour on a basis of a 10-hour day and hauling 1½ ton loads a distance of 12 miles loaded and 12 miles empty, the cost is 42 cts. per ton mile, as compared with the rate of 33 cts. per ton mile which is being charged for 1920 truck hauling. It should be understood that the above hauling includes sand, cement, lumber and piling, the latter ranging in length from 12 to 24 ft.

Performance of Nash Truck in Decatur County, Iowa

The following data on the performance of a 2-ton Nash truck, engine No. 99115, driver Geo. Arney, are contributed by Mr. F. G. Mallette, County Engineer:

Initial cost, chassis and cab complete	$ 2,004.77	
Fixed cost, 6% on investment	120.29	
Operating cost:		
Driver	$ 869.13	
Gasoline (1680)	397.84	
Oil (216 qts.)	32.45	
Grease and waste	20.77	
Repairs and renewals	583.34	
Depreciation	902.38	$2,805.91
Total fixed charges	$ 120.29	
Total operating charges	2,805.91	$2,926.20
Cost per ton mile (6,476)	.452	
Miles per gal gas. (1,680)	3.80	
Miles per qt. of oil (216)	30.00	

Recapitulation on Nash truck hauling for Decatur County.

Purchased May 8th, 1918. Sold November 11th, 1919.

	Miles	Gasoline	Oil	Repairs	Drivers	Depreciation	
1918	5,954	$296.04	$54.13	$321.36	$440.00		
1919	6,476	$397.84	32.45	583.34	869.13	$1,991.17	

Cost per ton mile	$	.401
Miles per gal. of gas		4.25
Miles per qut. of oil		37.0

Duplex Trucks Save Contract for Roadbuilders

A teamsters' strike prompted Bacon Brothers, road contractors of Flushing, Mich., to install Duplex Four-Wheel Drive trucks on their road construction work.

The teamsters made two separate demands for higher pay, and, as Bacon Brothers had made their bid on a

DIAMOND T

The Nation's Freight Car"

What it Costs to Move the Freight!

That's the most important factor in the selection of a motor truck. Others are of value because they influence *low final-cost.*

The heavy demands of road contractors, of engineers and of construction chiefs place unusual burdens upon trucks. Only the best can endure it year after year—economically, efficiently and without the constant need for repairs. In other words, only the best will prove low in final cost.

Shrewd purchasers know this. They *invest* in dependable transportation rather than *speculate* in more haulage units.

We can easily satisfy an open mind that every detail of Diamond T construction has been adopted because of its known and proven influence upon the final low cost of Diamond T transportation. Will you not give us the opportunity to supply detailed, specific information?

A Complete Line—1½ to 5 tons

Diamond T Motor Car Co.

Builders of "The Nation's Freight Car"

4564 West 26th St. CHICAGO, ILL.

road contract, based on a definite figure for transportation, it looked as though they would have to finish the contract at a loss, or default on it entirely.

Mr. Griffith, General Manager of the Duplex Sales Agency, heard of their plight and knew that he could solve their problems. He assigned a Duplex to their work and after two days' showing Bacon Brothers decided to standardize their hauling with Duplex trucks.

"After giving the Duplex a thorough trial and keeping track of expenses," said Mr. Bacon, "we found that we could deliver the gravel on the road for half of what it cost us with teams. The better efficiency of the Duplex gave us a fresh vision of the road-building business. We got busy right away, took on about $300,000 of road jobs and bought five Duplex trucks.

"After using them through the season and getting our grading done, we found that the trucks would operate in the winter as well as in the summer, and we have given our order for 10 more Duplexes so as to be able to push forward the work more rapidly and to warrant our taking further contracts.

"The trucks have given us very little trouble, and we have operated them over all kinds of roads and pit conditions, and have no hesitancy in recommending the Duplex truck for road building business."

Performance of Diamond T Trucks in Municipal and County Service

Mr. O. W. Spidel, City Forester, Board of Park Commissioners of the city of Milwaukee, Wis., advises that he has been using a 2-ton Diamond T truck almost daily since it was purchased a year ago. Although this truck was frequently overloaded and used in outlying districts on unpaved roads, and frequently on soft ground, hauling black soil from farm land for the planting of 3,000 trees along the streets of Milwaukee, the repair cost was nominal and in the overhauling of the truck this spring, Mr. Spidel reports that the several parts of it are as good as new. He is more than satisfied with this truck.

Mr. Felix Itz, County Engineer of Wabaunsee County at Alma, Kas., reports good service from the county's Diamond T truck. He states that hauling costs with the truck are about one-half that with teams. Moreover, the operation of the truck aids in the arrangement of some jobs which could not be carried on if team hauling were utilized. He cites as an instance the repairing of bridges that are from five to ten miles away from the material used in making repairs. If a team is sent it takes a long time to get to the site of the repairs and there is no time left for the party to repair the bridge and get back on the same day. However, by using the truck, there is plenty of time left after the material gets to the job to do the repairing and return to headquarters and get ready to go to the next job the following day.

Operating Dump Trucks in Conjunction With Steam Shovels

Mr. H. C. Shinn, Supervisor of Construction of the New Jersey State Highway Commission at Trenton, advises that he is equipping 2-ton four-wheel-drive trucks with dump bodies which he will use this year in hauling excavated material away from steam shovels. He expects to effect a material saving in hauling by this method due to the fact that teams now cost him $1 per hour.

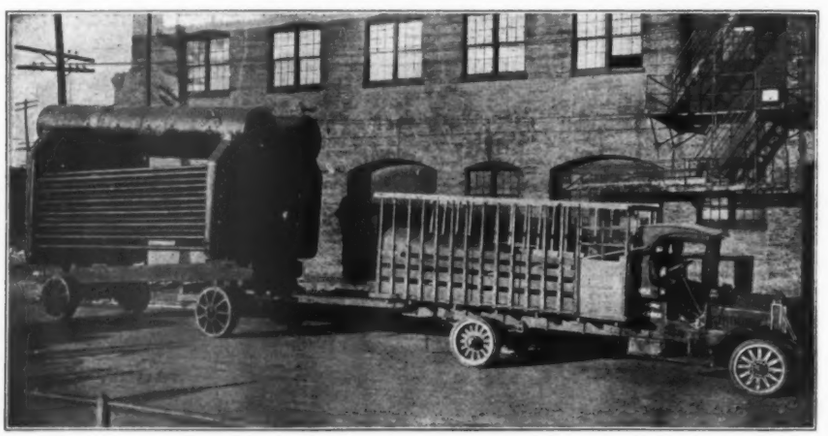
Performance of Stewart Motor Trucks

Mr. W. F. Schwartz Street Commissioner of the city of Buffalo, N. Y., reports the purchase of a 1¼-ton Stewart motor truck in the spring of 1916 for use in their Sewer Department, since which time it has been run almost daily with an aggregate mileage of approximately 40,000. While loads frequently have been heavy, the nature of the work requiring the use of all sorts of pavements, repairs to the truck have been moderate. The truck has given an average of 7 miles per gal. of gas in winter time and from 10 to 11 miles in summer. Mr. Schwartz states that while a great deal of credit for the truck's condition, which is still very good, is due to the care given it by the men who have run it, and who have always made their own repairs, yet the service received could not well be improved upon.

Mr. T. H. McElvein, Jr., Purchasing Agent of Erie County, New York, with offices at 76 Exchange street, Buffalo, reports the operation of four Stewart trucks by Erie County departments and states they have given perfect satisfaction. These trucks maintain a very high standard of efficiency and are in use throughout the year.

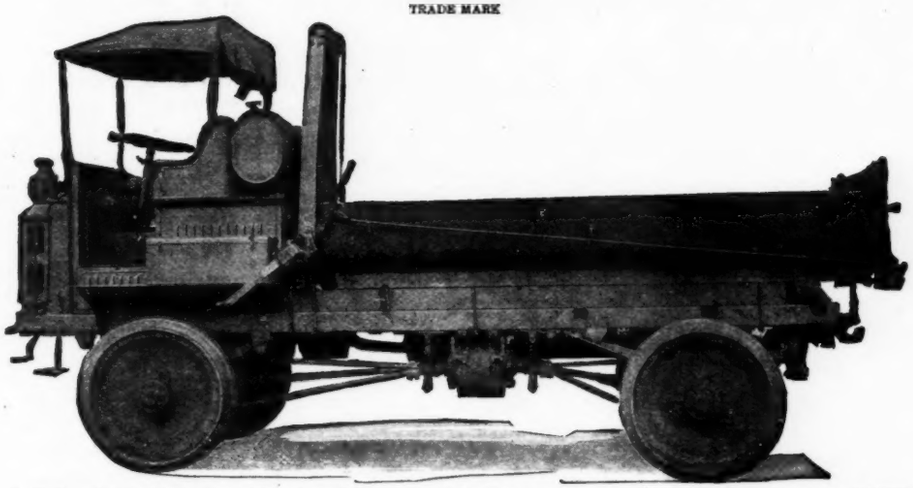
Using the Trailmobile

Mr. Joseph Wood, Assistant Commissioner of the Department of Public Works of the city of Pawtucket, R. I., advises that they have a Trailmobile in operation which was purchased in December, 1917. They have used it for hauling water pipes which previously had required a horse-drawn low-gear, and they have found that they could land the pipe faster and at less expense by the use of the Trailmobile than wth the former equipment.



DIAMOND T TRUCK WITH TRAILER HAULING STEAM BOILERS.

TRADE MARK



A Columbian Lightning Hoist and Dump Body mounted on one of the Government FWD trucks. The Indiana State Highway Commission has 65 trucks with this equipment.

Performance Counts In Road Building!

That is why the

Columbian Lightning Hand Hoist

PATENTED

is so often specified when purchasing road equipment. Its record of successful performance in the past assures you of its ability to serve you satisfactorily and economically in the future. No matter what kind of a truck you are using, the COLUMBIAN LIGHTNING HOIST in connection with a Columbian Steel Dump Body will increase the efficiency of your road building equipment by it's speed, capacity, and ease of operation.

The COLUMBIAN LIGHTNING HOIST is based on mechanical principles so simple that there is practically no chance for it to get out of order, yet so sound that one man can easily dump a 5-ton load. While it has been built with the idea of quality rather than price, yet the first cost is so reasonable that this, together with the absence of maintenance costs, makes the Columbian Hoist a most satisfactory purchase from the standpoint of economy.

Write us today for our illustrated circular No. 0000 and learn how Columbian Dumping Equipment can serve you.

COLUMBIAN STEEL TANK CO.

"TANKS FOR THE WORLD" "ESTABLISHED IN 1894"

1519-1625 WEST 12th STREET KANSAS CITY, MISSOURI.

Mr. William Wirt Mills, Second Deputy Commissioner of the Department of Plant and Structures of the city of New York advises of the use of two Trailmobiles by his department. Each of these Trailmobiles has a rated capacity of 1,500 lbs. They are used for the transportation of various materials needed in repair work on certain of the city's bridges and have been found serviceable and satisfactory for this purpose.

Using Oldsmobile Trucks in Cities and Counties

Mr. J. E. Williams, County Engineer of Shawnee County at Topeka, Kas., reports the use of an Oldsmobile truck during the past year in carrying the bridge crew to and from work over all parts of the county. The truck has given them continuous uninterrupted service for over 8,000 miles and seems to be "standing the racket" in good shape. The bridge crew consists of six to eight men and they carry shovels, bars, picks, saws, nails, chains and all tools necessary to use in bridge repairs and construction.

Mr. Burton Lowther, Chief Engineer and General Superintendent of the Board of Water Commissioners of the city of Denver, Col., writes that they now have three Oldsmobile ¾-ton trucks in their service. These trucks have been in use for about a year and they have have stood up under the hardest kind of usage in a very satisfactory way. Mr. Lowther states that the Water Commissioners are very much pleased with the performance of these trucks and would glady recommend them to anyone desiring a light serviceable truck.

Oldsmobile Fire Trucks Are Widely Used

F. H. Smith, Chief of the Fire Department of Chartley, Mass., advises that the Norton fire department purchased an Oldsmobile chassis about a year ago and had a body made to carry the chemicals and ladders. He states this apparatus has given very good satisfaction so far.

W. J. McHugh, Chief of the Ouray Fire Department, Ouray, Col., writes as follows regarding their Oldsmobile fire truck: "The truck, as you know, is rated at ¾-ton load capacity. We have equipped it with hardwood body with capacity for 1,000 ft. of 2½-in hose, one 40-gal. Champion chemical tank with all equipment including 200 ft. of ¾-in. chemical hose. Ouray is a mountain town and we have several streets in the city that are very steep in grades, but this truck has made all of the worst grades with apparent ease and with no harm to the truck. These tests were all made during the time of year when deepest and wettest snow was on the ground. This truck is everything we could desire in the way of fire apparatus."

Mr. G. J. Finn, Secretary of the Board of Fire Commissioners, Detroit, Mich., reports the use of three Oldsmobile chassis chemical wagons equipped with two 35-gal. chemical tanks. Each carries 500 ft. of 2½-in. fire hose. These wagons have been in service since Feb. 1 of this year and have given satisfactory results.

Mr. Charles A. Savarian, Superintendent of the Fire Alarm and Telegraph Emergency Department of the city of Portland, Ore., reports the use of an Oldsmobile truck on line construction work in the Fire Alarm Division of the Fire Bureau and on line troubles. He reports good satisfaction with about 8 miles per gal. of gas.

Mr. F. H. Grabner, Chief of the Baker, Ore., Fire Department, writes that about a year ago they purchased a ¾-ton Oldsmobile truck. When purchased the truck carried the usual bed, but this was changed and the Fire Department took all of the brass trimmings and ladder holders from a horse-drawn chemical that they had discarded and added these to the Oldsmobile chassis. A step was put on the rear and long running boards along the sides. These changes plus a coat of red paint produced a serviceable little fire truck of good appearance. They carry 1,000 ft. of 2½-in. hose in the main body. A light tray was installed on top of the main body and carries 200 ft. of 1½-in. hose all coupled with Siamese and nozzles attached. If the department has a residence fire they "lay in" with the 2½-in.; then if they think they can handle with fire with two small streams instead of putting on the nozzle on the 2½-in. line they pull out the Siamese and attach it to the 2½-in. and they have then two lines of that size. This arrangement does very good work. They carry an extension ladder, roof ladder, two 3-gal. chemicals, extra coats, two axes, bar and all tools necessary. They have had no trouble with the car since purchasing it. They make 30 miles per hour with it and have had it in some pretty bad places though it has never been stuck in the mud. The fire truck described is used in Baker in making fire runs to the outskirts of the town.

Motor Vehicles and Traffic Congestion

"The action of the Broadway Association of New York City in advocating the removal of car tracks and the installation of motor driven vehicles, is not only an indication of municipal progress, but an admission of the necessity of employing motor driven vehicles to relieve traffic congestion," says Henry Branstetter, Chicago Kissel distributor.

"A city or community's growth in traffic is the result of business expansion and it is up to every municipal government to see that traffic conditions are handled in the best interests of the city. We understand that invesigations have proven that a street devoted exclusively to motor driven traffic, will handle more people with less confusion and congestion than a wider street that accommodates both street cars and motor driven vehicles. If this is so, there isn't any doubt but that it will pay most cities to prohibit all vehicles but that of the motor driven variety on their principal thoroughfares to insure better handling of traffic and an elimination of traffic congestion."

Using Federal Trucks to Move 16,200-lb. Boiler

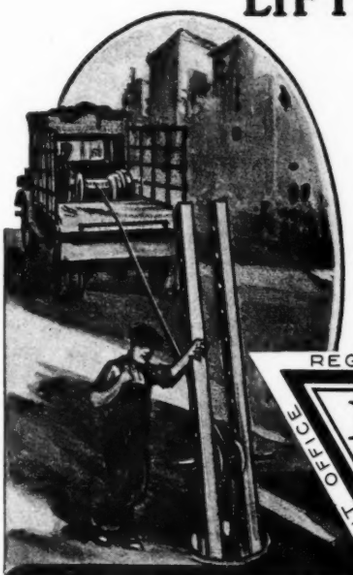
When Harrison Brothers of Toledo, O., were called upon recently to move a 16,200-lb. boiler, they chose a Federal truck for the task, although but two of their fleet of nine trucks were Federals.

The Austin Company of Toledo, that has the Standard Oil contraet, wanted an 8-ton boiler hauled from Dunkirk to Toledo, O., a distance of 70 miles. It was at first questioned whether it was advisable to move the boiler by truck. Harrison Brothers finally got the job on their promise that they would get the truck to Toledo without mishap. The huge boiler was rolled along to its destination as though it were an ordinary every-day load.

The Federal truck that performed the task was not a

MEAD-MORRISON SERVICE

LIFTS THE LOAD OF INDUSTRY

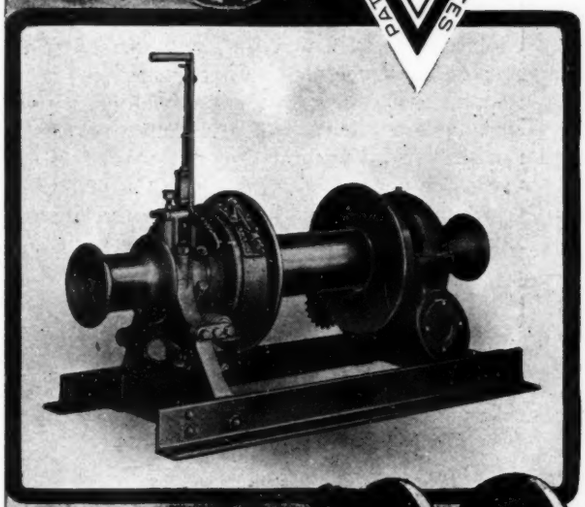


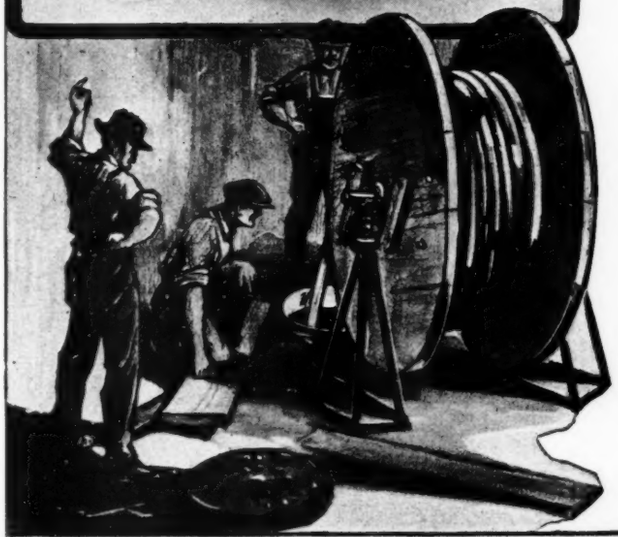
More productive hours! Two hours a day—for each man on the truck and the truck itself—over 600 hours a year for each—over 1800 hours when the truck carries two men.

Such is the demonstrated achievement of Mead-Morrison Engineers, proving indisputably that the ideal of Mead-Morrison—to increase the productive hours of industry—is being carried out in a sound, practical way in

REGISTERED IN UNITED STATES PATENT OFFICE
MM CM

MEAD-MORRISON Truck Winches





Both types of Mead-Morrison Winches, the Vertical Capstan and the Friction Drum, have thoroughly demonstrated their practical worth in reducing costs in handling heavy, bulky loads. The Friction Drum Winch, shown pulling telephone cable through the conduit, is but another illustration of its worth in reducing costs on the "out-of-the-ordinary" job. In this case it actually released five men for other work, and with fewer men made a 50% increase in the amount of cable installed.

The Mead-Morrison Motor Truck Winch Folder conclusively proves there is a real saving when you "let the engine do the work." Send for one.

MEAD-MORRISON
MANUFACTURING COMPANY

526 Prescott St. **EAST BOSTON, MASS.**

new one. It had been owned and used by Harrison Brothers for three years, in the hard kind of work that usually falls to a general trucking company.

Building Highways for Truck Traffic

"Despite the magnitude of the good roads movement, which has been one of the greatest institutional developments of the last decade, it has not kept pace with the growth of motor transportation as a unit in America's commercial system."

This was the opinion expressed recently by E. A. Williams, Jr., President of the Garford Truck Co., who believes business men should give more attention and cooperation to state, county and city road boards throughout the country, with a view to making highways more worthy of their vehicles. Unless, in Mr. Williams' opinion, something is done to assure more construction of roads of the type adaptable to general use instead of restricted traffic the full possibilities of truck transportation cannot be realized. This realization cannot come for several years unless a revision is made in road building codes.

Mr. Williams pointed out in substantiation of his idea the manner in which truck usage has grown in leaps and bounds, particularly since the war, during which the leading position held by the motor truck in the country's transportation system was demonstrated forcefully.

Now comes the problem of making the roads meet the requirements of heavy truck duty. Unless the highways, particularly inter-city highways, are made ready for trucking operations it will mean the loss of millions of dollars and cause serious injury to domestic commerce in the near future because of the necessity of rebuilding to suit truck traffic. Business men will demand the rebuilding as they begin to realize more fully the vital part played by the truck in the transportation field.

The truck has been even more faithful an ally to the railroads in relieving transportation congestion than some of the shrewdest transportation experts calculated. Consequently it has been adopted more rapidly in all lines of commercial activities than was anticipated.

Agitation by transportation experts of a movement to secure industrial surveys of highways, particularly those linking towns and communities, for the purpose of ascertaining their adaptability to motor truck transportation for short haul duty as a relief to congested railroad conditions has aroused a wave of interest among shippers, manufacturers and truck makers. The general concensus of opinion of those interested men who know the importance of the transportation system in the country's commercial activity is that the plan will do more than any other factor to solve the shipping problems with which big business is confronted.

Motor truck manufacturers, who probably are in a better condition than anyone else to visualize the national transportation needs and who know the tremendous demand for trucks to handle inter-city and inter-community hauling, are unqualifiedly in favor of the project.

Motor Transportation During the "Outlaw" Railway Strike

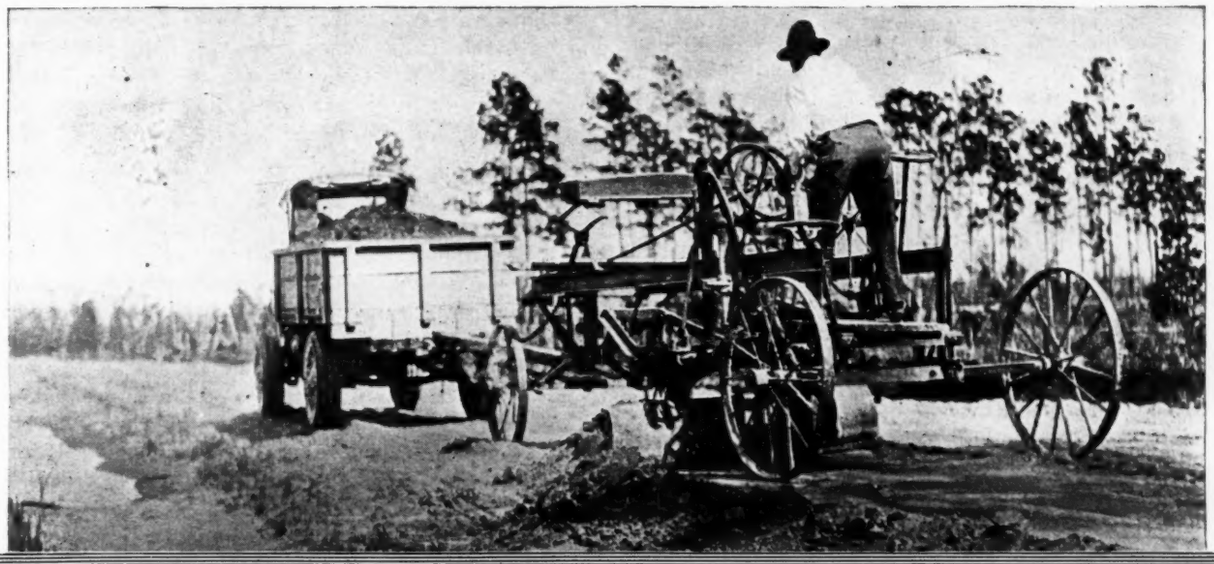
The freight tie-up as a result of the "outlaw" railway strike has resulted in another turn in the evolution of the highway as a national public utility and once more emphasized the necessity of constructing a system of National Highways with as little delay as possible.

The Federal Highway Council, a body formed for the specific purpose of developing the construction and use of the public highway along national as well as state and county lines, took an immediate and active part in cooperation with various communities in moving freight by motor truck in congested areas. The Council was in telegraphic communication with leading centers throughout the country at all times during the tense period.

STANDARD 5-TON DUMP TRUCK AT WORK ON A CONSTRUCTION JOB.

DUPLEX TRUCKS

BUILT FOR BUSINESS



The Duplex Limited

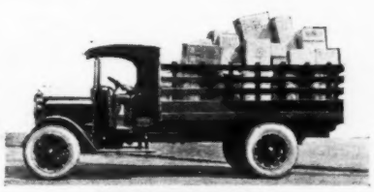
High Speed—Pneumatic Tired—Medium Capacity—Full Electrical Equipment —Here Is a Truck That Does Its Work Economically

ONE of the significant developments of these times in the truck industry is the increasing tendency for men to *buy* their trucks—and to let fewer and fewer be sold to them.

Look at the success of the Duplex Limited. Already it is an established success—with a steadily growing demand coming from all sections and from men in all lines of business.

If you contemplate buying a truck of medium capacity, look over the Duplex Limited. Have your local Duplex dealer show you the Limited. Note its wonderful ruggedness and mechanical superiority.

It is a Duplex through and through —and as such a very safe investment for all general hauling.



CITY OF BIG RAPIDS, MICH.

Gentlemen:

We purchased a Duplex Truck with a three-yard dump box about November. * * * * * * * * All the above trucks came here and were put through the same tests. The Duplex did our work the best and we ordered one and have not been sorry for it.

Our gravel pit is 2.5 miles from the city. One-half mile of road near the pit is very sandy and soft. The wheels of the truck settled in the sand about nine inches the first trip; after that we had no trouble. Our teams were drawing 1¼ cu. yds. to the load, making three trips a day of ten hours total.

The Duplex Truck drew three yards of gravel a load and made nine trips a day of ten hours, making 27 cu. yds. at a cost of $5.50, which includes driver, gas and oil; cost of drawing gravel with truck, approximately 21 cents; cost of drawing with team, $2.16, making a saving with truck of $1.96 per yard.

Yours very truly,
Dan H. Vincent, Gen. Mgr., Big Rapids.

FACTS like these are typical, wherever contractors use Duplex Trucks in road building.

They explain why the Duplex 4-Wheel Drive is steadily replacing all other forms of transportation where heavy hauling over rough roads is a requisite.

The chief factor in Duplex better service is the superior traction of the Duplex 4-Wheel Drive. And the reason for this superior traction is that every wheel, both front and rear, does its share of propelling the load.

And because of the same principle the Duplex never fails in an emergency. It will move the load wherever any one wheel can get traction.

There are reasons of vital efficiency and practical economy why every road commissioner should get facts and examples of Duplex successes in building better roads and in building them better and cheaper.

DUPLEX FOR BUSINESS

Duplex Truck Company
Lansing · Michigan

One of the Oldest and Most Successful Truck Companies in America

During the unauthorized strike Gov. John J. Cornwell of West Virginia was in Washington and wanted to get back to Charleston. The governor was informed that the strike made the departure of trains uncertain, so at once he made arrangements to go via the public highway and automobile.

West Virginia next fall will vote on a constitutional amendment that will make possible the bonding of the state to the extent of $50,000,000 for the building of good roads. This is Gov. Cornwell's proposition. He wants his state to have as complete a system of articulated roads as any other. That's why he sets an example whenever he can to show his people the value of good roads.

"If we had in this country a system of good roads covering every state, railroad strikes would have no terrors for us," said the Governor. "We would not then be dependent upon the whims of a few men. And it is coming. Eventually we shall have highways over which we can haul to markets all of our farm products. The development of motor trucks for heavy hauling is a matter of only a short time, and I am confident that within a decade we shall have a highway system that will make us virtually independent of the railroads in emergencies. Today, however, a railroad strike is a very serious matter. In West Virginia, for instance, sections, inside of a week or ten days, will be entirely out of food supplies if the railroad strike should continue. Good roads draining every community, large or small, would make such a situation impossible.

Speaking in support of the proposed National Highway Act, now pending in Congress, Senator Townsend, chairman of the Senate Committee on Post Offices and Post Roads, said, in reference to the critical situation, "If you want to promote general prosperity, protect against railroad strikes, and promote the general welfare you will favor such a system as I propose."

Overloading Trucks and the Use of Trailers

The following good advice with reference to the overloading of trucks and to the use of trailers is given by by Pierce-Arrow Motor Car Company:

Overloading

Don't load your truck beyond its normal rated capacity. It was designed and built to carry that load. Certainly it may carry more, but this practice invites inevitable loss. To state that your trucks are overloaded is merely another way of saying that you are materially shortening their useful life as well as decreasing their range of activity.

An overload increases the stresses in the weight carrying-members and may cause excessive breakage of these parts.

In any good truck, normal weight, hence normal stress, produces normal wear of moving parts. An excess will necessarily result in abnormal or excessive wear.

A truck frame and other parts may be compared to a bridge. When a bridge is rated at so many tons, it means that it can carry that load with a certain margin of safety. It will carry more, but the margin of safety which was provided to take care of its depreciation in normal service will not be as large. The same is true of the truck.

Overloading decreases the ability of the truck to negotiate road conditions since there is a greater weight to be moved per unit of engine power. A result is excessive gasoline consumption and slower operating speed; therefore, greatly reduced efficiency.

The Use of Trailers

Although the use of trailers or semi-trailers is feasible and profitable under many conditions, the truck owner always should consult the truck maker before installing such equipment. Adverse operating conditions sometimes would make the use of trailers ruinous.

Given proper conditions, however, the trailer or semi-trailer fills a definite need. Some of the many things that trailers can do are: (1) Reduce load-handling delays, by enabling the operator to load or unload one trailer while the truck is hauling another; (2) haul units too heavy for a single truck but which can be moved with the power of a single engine, such as boilers, heavy machinery, etc.; (3) carry bulky but light articles which would utilize only half the power of the engine if loaded on to a single truck. Barrels and boxes are in this class; (4) haul lengthy material too long to be loaded onto a truck, such as ship masts, motor boats, timbers and poles; (5) introduce trucks more extensively into the lumber trades by overcoming the unprofitable loading and unloading delays through the use of detachable and interchangeable semi-trailers; (6) increase greatly the carrying capacity of passenger buses.

The transportation departments of progressive truck manufacturers have made extended investigations and study of trailers and are in position to give honest advice as to their desirability under specific conditions. The question of what tractor gear ratios should be specified, of whether semi-trailers or four-wheel trailers should be used, of the method of attaching, all enter into the problems surrounding their use and the expert services of truck and transportation engineers should be enlisted before a decision is made.

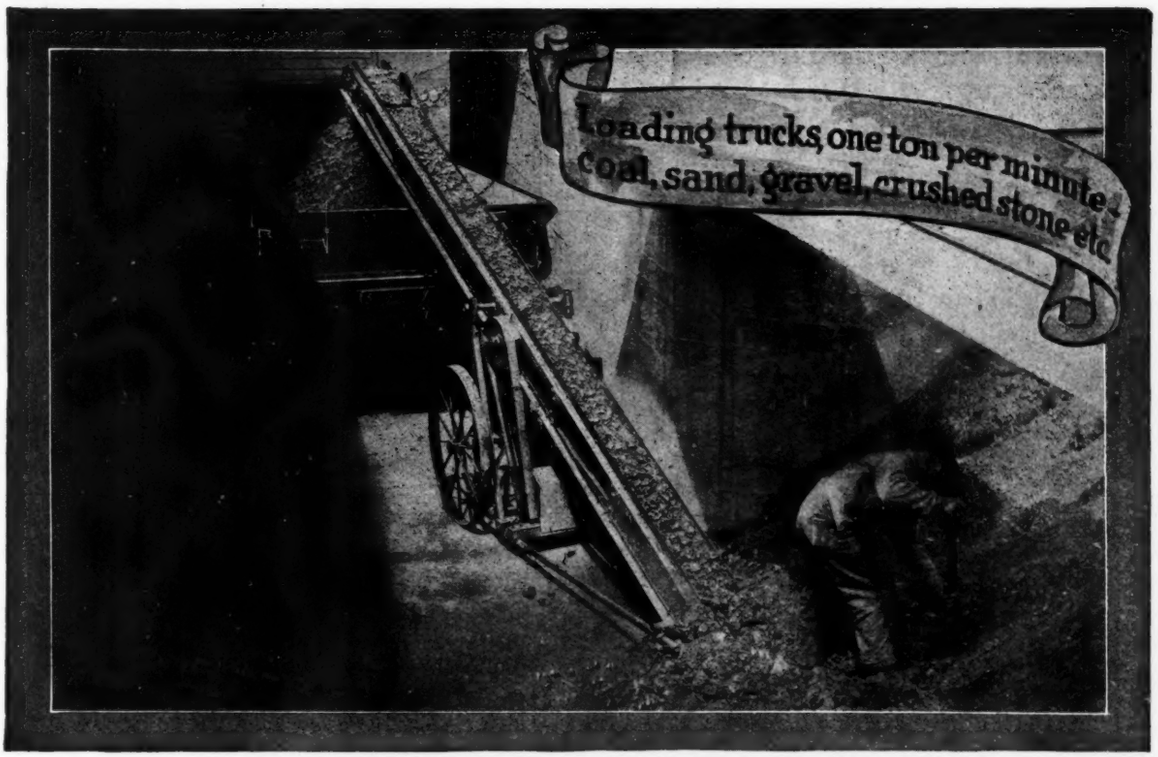
Overloading Dump Trucks Is Poor Business

An articles entitled: "Overloading Dump Trucks Is Poor Business," written by Mr. F. L. Henk, Managing Secretary of the Detroit Transportation Association, and printed by the Acme Motor Truck Co. of Cadillac, Mich., is here reproduced. The comment on the article is added by the company named. Both article and discussion are very timely. The article and discussion follow:

The march of progress of all great cities brings with it intensive activity in the erection of gigantic buildings necessary to house the increasing industrial growth. It is in the erection of such buildings that the motor truck plays an important part, particularly during the initial building stages—the excavating.

Dump motor trucks have been used in excavating work since 1914. Probably one of the first jobs on which dump trucks went into an excavation and brought out their loads was the excavation of 700 ft. of tunnel in New York City, from Park Place to Mulberry street. The excavating contracting firm of Holbrook, Cabot & Rollins handled the job. This work was done during the summer of 1914. Since that time the dump truck has been perfected to its present high state of efficiency.

The use of the dump motor truck has effected much economy in excavating work, but there is one phase which



The SCOOP CONVEYOR

An original, distinctive and serviceable labor-saving machine for storing and reclaiming, loading and unloading cars, trucks and wagons.

DOES THE WORK OF FROM 6 TO 12 MEN

and keeps equipment moving. Speeds up deliveries. Saves car demurrage. Eliminates much shovel and wheelbarrow work. Enables men to work faster and easier. Does three to five days' work in one.

OVER 2,000 USERS

and about one-half of our sales are "repeat orders."

Write for Catalogue No. 100

PORTABLE MACHINERY CO.
Passaic, N. J.

has developed in the use of these trucks which threatens to do a lasting harm to the industry of dump truck hauling and inflict a severe wound on the motor truck industry in general, and that evil is the evil of overloading.

Principal Danger in Winter

There is not much danger of this evil during the summer months, as there is usually plenty of work for the dump truck, but during the winter months, taking advantage of the slack conditions, some so-called "excavating contractors" have seized the opportunity of placing immense overloads on dump trucks in their employ. The dump trucks which the excavating contractor claims he is operating are usually trucks which belong to individual owners, who are purchasing them on a time basis, the trucks being bought on a down-payment of 25 per cent., with the balance payable in twelve months. With the present high cost of motor trucks, the monthly payments are of course high. It is at this point that the individual operator is coerced into working his truck overloaded. He sees the business of excavating dropping off, and fearful of his obligation to the truck dealers, he sells his services to the excavating contractor at a rate which is below the actual operating costs of his truck, and permits the truck to be overloaded, little dreaming of the disaster which awaits him.

That truck manufacturers agree on this point is proved by the following quotations from a treatise on overloading prepared by the Packard Motor Car Company:

"Overloading is a most dangerous abuse of a motor truck. Truck abuse, whether it be overloading or anything else, is a grievous offense against business, because it blocks the progress of transportation. Transportation is the life-blood of business. Millions of tons of freight are accumulating in this country every day. The task of moving it is too great for the railroads, even in their own sphere. A system of motor truck transportation is needed to help the railroads. Intensive transportation that can be supplied by motor trucks is absolutely necessary to permit further industrial development in this country. It is the duty of business to see that it does nothing that interferes with the development of this transportation system."

Narrowing this subject down to the field of the building contractor and the hauling contractor, it is clear that they both, as business men, have a duty toward this new transportation system.

If the building contractor insists on overloading the trucks on his job, the axles, tires, wheels, springs, frames, brakes, transmission and engines of those trucks are going to be prematurely worn out and extremely expensive to maintain before they finally do come to an untimely end.

In order to make a success of the system of motor truck transportation it is necessary for the trucks to be making a profit for their owners. The owners must be in a position from the start to know whether their trucks are making or losing money. An overloaded truck is never making a true profit. What it earns temporarily by hauling overloads, it will lose in repairing and replacing the parts worn out by the strain. It will have to be relegated to the scrap heap before its time, leaving nothing but a trail of waste in its wake."

The Detroit Transportation Association, as representing 260 commercial hauling concerns in Detroit, wishes to place itself on record as unalterably opposed to the overloading of dump motor trucks. We believe that with the present state of curtailed production in all lines of work, the conservation policy in effect during the war should be continued until such time as conditions are again normal. At present, motor truck production is not up to the demand, and the premature wearing-out of dump motor trucks, with the attendant slowing-up of excavation work brought about through break-downs, etc., is a serious question which we believe is blocking the proper development of the motor truck in one of its most important spheres—excavating.

Not only does overloading ruin the individual operator of the truck who persists in it, but it also hurts the motor truck industry at large by engendering a feeling of distrust in the mind of the truck operator as to the real merits of the motor truck he owns—and overloads. Premature wearing-out of parts leads him to believe that the truck is of faulty construction and he does not think to blame, not the truck, but the overloading.

Railroads are very careful not to overload rolling stock. They know of the dangers of such methods. Bad freight train wrecks taught them that overloading railroad cars was a poor paying proposition. Brakes on an over-loaded vehicle do not work properly. An overloaded dump truck running through streets is a menace to the public. A truck of large capacity, fully loaded, requires a maximum of skill and power to bring it to a quick stop, as is often necessary in our ever-increasing congestion of traffic. If a truck is over-loaded, the

ACME 3½-TON TRUCK, MAKING A ROUND TRIP OF FOUR MILES IN TWENTY MINUTES, FOR CONTRACTOR BERT SNIFFEN, OF GENEVA, N. Y., HAULING STONE FOR THE FINGER LAKE ROAD.

"My Kissel Truck is always ready for work—a necessity in road building."

C. H. WITTENBERG, Road Contractor and Builder, Hartford, Wisconsin, purchased a 3½-ton Kissel "Heavy Duty" Truck, equipped with dump body and hydraulic hoist, for use on highway road work, hauling stone, screenings and gravel, giving continuous service during the entire year of 1919 on Waukesha County highway work. The truck averages 1,100 miles per month, carrying 4 cubic yards of stone, weighing from 10,000 to 11,000 pounds.

In addition to this 3½-ton Kissel "Heavy Duty" Mr. Wittenberg has 2 five-ton trucks of another make on the job, and a careful check showed that his Kissel was hauling equal loads, bucket for bucket, with the other trucks, showing the substantial and built-in qualities of the Kissel and proving its equal earning capacity to the five-ton jobs at less investment.

Photos 1 and 2 above show Mr. Wittenberg's loading equipment.

Photo No. 3—Mr. Wittenberg's "Heavy Duty" Road Builder on its way to the stretch of road being built up.

Photo No. 4 shows the Kissel "Heavy Duty" spreading its load without the driver leaving his cab.

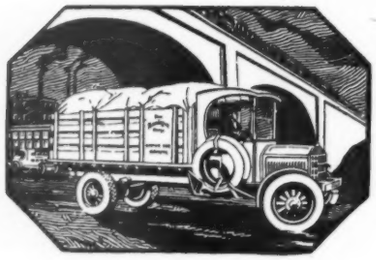
Photo No. 5 shows the truck returning over the same road after spreading its load.

***Send for Kissel Performance Proof in Highway Building*—a series of folders containing data and statements of Contractors employing Kissel Trucks in different kinds of road work.**

Kissel Motor Car Co.

Hartford, Wisconsin, U. S. A.

GARFORD



Low Cost Ton-Mile is Garford experience and efficiency written into daily hauling service. The test is on the road and the proof is in expressions of satisfaction from users everywhere, such as this:

City Luxerne Town
State Penna. Date 10/15/19

The Garford Motor Truck Co.,
Lima, Ohio.

Gentlemen:
The following is the record of my Garford motor trucks:

Cap'city 1½ tons. Yrs. of service 3 Avr. miles gal. gas 13 Repairs $ 72 Tot. Mil'ge 24000
Cap'city ..... tons. Yrs. of service ..... Avr. miles gal. gas ..... Repairs $ ..... Tot. Mil'ge .....
Cap'city ..... tons. Yrs. of service ..... Avr. miles gal. gas ..... Repairs $ ..... Tot. Mil'ge .....
Cap'city ..... tons. Yrs. of service ..... Avr. miles gal. gas ..... Repairs $ ..... Tot. Mil'ge .....

Remarks Have run truck every workday for the past 3 years it works as well and smooth as when new.

(Signed) W. N. Frankenberry

Garford

Lima, Ohio

That the United States Army has made Garford a Class A Standard is another proof of Garford serviceability.

TRUCKS

operation is made doubly hard and the brake mechanism is called on to perform a task for which it is not built.

Summing up all of these points, it is easily seen that overloading dump trucks is mighty poor business, and the excavating contractor who persists in overloading is traveling on very unfirm ground.

The above article deals principally with dump trucks with which the overloading evil has been the most prominent. The results of overloading however are the same regardless of type of body and the wise truck owner who has his own best interest at heart is the one who recognizes a truck's limitations.

The purchase of a truck, whether by corporation or individual, represents an investment intended to be a profitable investment and give long, continuous service to its owner.

To perform satisfactorily the service for which a truck is intended, its owner must recognize that the responsibility for such satisfactory service rests almost wholly with him.

Don't be the goat for the excavation contractor by allowing him to overload your truck and jam it to pieces with a steam shovel without recompense. When operating teams you would quickly call a halt. It's just as disastrous to overload your truck.

Before going on to a job have an understanding as to maximum load to be hauled, the remuneration for the same and the contractor's liability for damage done by the steam shovel. If you and every other truck owner going on to a job would get together on these points you could curb this overloading abuse and form of robbery which actually takes money out of pour pocket and puts your truck on the junk pile in a year when you should get not less than five years' profitable service out of it. Now, when the demand for trucks greatly exceeds the supply, is the time for truck owners to correct these evils.

Don't overload, don't overspeed, drive carefully over rough roads, see that your truck is well lubricated and adjustments made when necessary and your truck purchase will prove to be a most profitable investment.

City Traffic Will Demand Truck Freight Terminals

Freight terminals designed and operated exclusively for motor trucks in the large cities of the United States will be the next stage in the development of highway transportation, according to R. E. Fulton, vice president of the International Motor Company, manufacturers of Mack trucks.

"With appropriations that have been estimated to total nearly a billion dollars available for building roads in 1920, it is only necessary to enlarge highway construction facilities before we will have a comprehensive network of these trade arteries that will bring goods from hitherto undeveloped territories into large cities," says Mr. Fulton.

"It must be remembered, however, that with this increase in the number and capacity of highways will come increased demands upon the traffic resources in cities, and that the result will be serious congestion unless city traffic facilities are increased to offset the effects of outside highway construction. Since it is practically impossible to

ACME

Stronger—More Powerful

IN building and maintaining highways, there are distinct advantages in selecting the **Acme** Truck. Allen County, Ind., owns and operates two 3½ ton **Acme** Trucks, and the superintendent tells us he has found that the **Acme** is a stronger truck. "It is more powerful than the others, has less expensive upkeep. Our **Acmes** have been absolutely satisfactory in every way and they have always done whatever work we have required of them."

Acme is the choice in engineering and construction work—practically 21% of all the **Acmes** built go into this service. It is designed, built and shipped ready for service, even to the complete body. **Acme** owns and operates its own wood-body and steel-body building plants.

The **Acme** seal is your guarantee of proved construction. It is your assurance of the industry's proved units correctly assembled by **Acme** engineers in a well-balanced truck.

Built in 1, 1½, 2, 3½ and 5 ton capacity

Acme gives known standards of service and performance. Write for our catalog and partial list of **Acmes** in service.

Acme Motor Truck Company

191 Mitchell St. CADILLAC, MICH.

The Seal of Dependable Performance

ACME THE TRUCK OF PROVED UNITS

Trade Mark Registered in U.S. and Foreign Countries

build more city streets or to widen them, it will be necessary to distribute freight more efficiently. This can be done by establishing motor truck freight terminals for handling small shipments, similar to the railway terminals, each to serve as a clearing house where outgoing and incoming loads can be assembled and distributed. Such a system implies the co-operation of the motor express concerns both in delivering merchandise and in obtaining return loads.

"Motor truck freight terminals would thus be a benefit to both the motor express concern and to the city—to the former by lowering delivery cost and insuring return loads, and to the latter by providing a means for offsetting traffic increases."

GRAMM PIONEER BERNSTEIN

All Gramm-Bernstein worm drive models carry, as standard equipment, accessories which are essential to the satisfactory operation of any truck, and which are worth $550 to $600 at today's prices.

The Gramm-Bernstein Motor Truck Co.

LIMA, OHIO, U. S. A.

Builder of the First Liberty (U.S.A.) Truck

THIS IS THE

Heltzel "Lightning" Loader Skip

It is perfectly designed and built for its special purpose—strong and rigid, properly reinforced and fortified.

Collapsible—readily moved about.

Adjustable to any condition—high car, low truck, or vice versa—easily operated. It will decisively cut operating costs and increase profits.

The Heltzel Steel Form & Iron Co.

WARREN, OHIO.

HAUL IT IN A HALL

GREATER STRENGTH AND POWER

HALL Trucks have won a special preference in the field of heavy hauling.

It is a preference based on excess strength and excess power guided without undue weight.

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EDITORIALS

TOWNSHIP FIRE PROTECTION

Recently the General Assembly of the state of Ohio passed a law authorizing township trustees to provide against fires and to provide and maintain fire apparatus and buildings for the use of volunteer fire companies.

Under this law the township trustees may establish all regulations necessary to guard against the occurrence of fires and to protect the property and lives of citizens against damages and accidents resulting from fires. When a volunteer fire company has been organized for service in the township, and of such character as to give assurance of permanency and efficiency, the trustees are empowered to purchase for the use of the fire companies such fire apparatus and appliances as may seem advisable. Trustees are also empowered to provide for the maintenance of fire equipment and to purchase, lease or construct and to maintain such buildings as may be necessary for housing the apparatus. They may also establish and maintain lines of fire alarm telegraph within the township.

The trustees are authorized to levy sufficient taxes to provide protection against fires and to provide and maintain fire apparatus and buildings for the use of the fire company. If 10 percent of the electors of the township petition the trustees requesting the submission of the question of issuing bonds in a sum not exceeding $20,000 for these purposes, the trustees are directed to submit the question to the voters at a special or the next general election.

If a majority of the votes cast favor the issuance of fire protection bonds, the bonds are to be issued and marketed in the usual way. The proceeds of the bonds are to be placed in the township treasury to the credit of the fire equipment fund.

The improvement in the class of farm buildings which has been so noticeable in recent years, clearly calls for improved fire protection in rural districts. The expensive farm house has long been a poor risk for the fire insurance company because of a lack of fire protection and fire fighting facilities, and insurance rates on such buildings have been correspondingly high. An improvement in the fire protection of such buildings will, eventually, lead to a reduction in insurance rates providing the highways of the township are passable at all times. We do not believe that any provision for the protection of rural buildings against fire will be adequate and fire insurance in such districts will not be reduced, unless buildings are located on highways over which modern fire apparatus can pass quickly at any time of the day and in any season of the year.

It has been observed that in many small cities and villages having modern motor fire apparatus the value of such apparatus is largely nullified to owners of homes in the outskirts of the city because of poor pavements or the lack of pavements. Oftentimes heavy motor fire apparatus has mired down and become temporarily useless in attempting to reach a fire in some building outside the paved portion of the city.

It must be apparent, therefore, that this movement for improved fire protection in townships must succeed or fail with the success or failure of local efforts to provide dependable highways. A stretch of even a few feet of mud road may be sufficient to defeat all of the fire protection efforts of the township. It is, therefore, of prime importance in this movement for better rural fire protection to provide highways capable of carrying modern motor fire apparatus at any time.

IN THE INTEREST OF STRAIGHT THINKING

It has been remarked that the progress of the American Association of Engineers in the stream of professional advancement was, for a time, "blocked by the ice of conservatism." It is true the ice has been broken and large blocks of it may now be seen moving noiselessly along with the current. Ten thousand new members in a year is an argument favoring the aims and accomplishments of the Association which cannot be ignored by those with open minds.

There is still some honest opposition to the Association among those who look upon it as a species of trade union. This view is compounded of loose thinking based on little information. As a plain matter of fact, but for the Association the salaried portion of the engineering profession would have become by now, in all probability, a trade union of the purest type.

Mr. L. K. Sherman, President of the United States Housing Corporation, and newly elected president of the Association, forcefully called attention to this fact in the inaugural address delivered at the annual convention in St. Louis on May 11. Speaking of the reaction from the spirit of self sacrifice, generosity and harmony which characterized the war period, he said:

"The restraint of the individual has been removed and the pent-up combative spirit of selfishness, greed and intolerance has broken into the flames of radicalism. Almost every separate trade, industry, business or profession today is organized for its material ends. . . . Radical thought has not been confined to the trades. We have seen examples of scores of the most

highly trained and specialized men carried off their feet in one evening's meeting to accept membership and dictation in the closest form of trade unionism. . . . The Association has been the means of preventing the exodus of thousands into the alternative of trade unionism. The A. A. E. is conserving the unity and integrity of the profession. For this the thanks and respect of those most honored members of the old school are due the American Association of Engineers."

Selah! Or, as we moderns say: Stop and think!

AN ENGINEER IN POLITICS

At last we have what engineers have wanted for many years: an engineer candidate for a presidential nomination. Herbert Hoover may fairly be called the engineer's choice for the presidency, if we are to judge from endorsements of his candidacy by engineering societies and by engineer's branches of political clubs.

We have received an interesting letter from the Engineer's Branch of the Hoover Republican Club of Illinois which states that the engineers of Illinois are organizing to show the Republican nomination convention that they are for Hoover for president.

The Hoover Engineers' Committee enumerates several reasons why they favor him, including: His great technical and successful business career; his wonderful gift for organization, as shown in Belgian Relief and Food Administration Work; his intimate knowledge of world-wide conditions and men; his ability to get their best efforts from his associates, and his training, education and experience as an administrator of the highest type.

If Mr. Hoover is indeed the choice of engineers for the presidency we wish him well. Undoubtedly he would make a good president and, early in his administration at least, he should be popular. Quite likely after this honeymoon period various individuals would begin finding fault with him in the regulation manner. However, as stated, if he wants the place and engineers want him to have it, we are for him.

Is this a partisan, political editorial? Not at all. How could one be accused of partisanship in discussing the candidacy of Mr. Hoover? This is at least a bipartisan discussion, if it is not nonpartisan, for isn't he a liberal competing for the nomination by the conservative party? It may happen, though we hope our fears are unfounded, that in pressing toward the mark with his eyes fixed on the presidency as his goal, he may stub his toe on the first hurdle, namely, the nomination. It is just possible he might have done better, entertaining liberal views, had he sought the nomination at the hands of the liberal party. We fear that some conservative old Isaac at the Republican convention may remark that while the hands pass acceptably for those of Esau the voice is unmistakably that of Jacob.

A LIVING WAGE FOR THE ENGINEERING EDUCATOR

Teachers in engineering colleges are among the "forgotten men" with respect to compensation in money. Many of them are feeling the merciless pinch of poverty and unless soon relieved will abandon teaching for some other form of employment paying a living wage. It would be easy, from the data in hand, to draw a picture of the financial distress of these worthy men, but we need do no more than remind the reader that the salaries of engineering teachers which made close figuring necessary five years ago are still in effect in many, if not most, cases, and are insufficient to maintain either health or happiness from day to day, to say nothing of saving for old age. Something must be done, and done quickly, to provide better pay for engineering educators or the cause of engineering education will suffer a blow from which it will not soon recover. We are nearing the end of the school year, and unless funds are provided, in some manner, for the adequate payment of engineering teachers next year, we predict that a very great many of these men will terminate their teaching work with the present collegiate year.

This is a matter for all of us to face squarely and at once. First of all we must disabuse our minds of the foolish school-boy prejudice against teachers. In the present scheme of living the teacher performs an indispensable service and we must recognize that fact. We simply must have teachers and we should demand good ones. And the good ones should demand adequate pay, so that they can feed and clothe their families properly, safeguard health, keep their life insurance policies in effect, and provide for the scale of living essential to the happiness of people of culture and refinement.

These men have continued teaching thus far because of their love for the work. Surely engineers can appreciate this spirit for it has kept them in engineering when fortune beckoned elsewhere. But conditions have become so acute that the teachers cannot go on much longer without relief. They will be left no choice but to resign and accept any one of the offers frequently made all successful teachers by commercial organizations.

We hope the engineering colleges can secure more funds but if they can't they must live on what they have. It should be considered a disgrace to any college to spend another dollar for new buildings or new equipment until the teachers have been given salaries on which they can live. Colleges must shake off the "boom town" fever and get down to the bedrock of justice to the teacher. Without good teachers the finest university plant will be but a mockery of the cause of education. Let us have done with the physical expansion of the university until it has been made sound at heart.

Construction and Inspection Methods Employed in Building the County Brick Pavement Connecting Waterloo and Cedar Falls, Iowa

By E. A. Zack, Resident Engineer, Iowa State Highway Commission, Ames, Iowa, and C. M. Fisher, County Engineer, Black Hawk County, Waterloo, Iowa.

Black Hawk county's first paving project is a trifle over four miles in length and connects the cities of Waterloo and Cedar Falls. Waterloo has a population of about 35,000 and Cedar Falls of 6,000. Both towns have several manufacturing enterprises and wholesale houses from which originate considerable truck traffic from town to town. There are at least three regular truck routes, and several tourist routes, namely, the Grant Highway, Red Ball Route and Iowa Parks Highway, which follow this road. In addition, most of the adjacent land is included in the incorporated towns of Cedar Heights and Castle Hill, prosperous residential suburbs. From all these sources very heavy traffic, both commercial and pleasure, use the road, necessitating a substantial type of pavement.

Bituminous-Filled Brick Pavement on Concrete Base

The contract for the work was awarded June 20, 1919, to the Moore-Young Construction Company of Waterloo, and construction began early in June. The contract price was 65 cts. per cu. yd. for grading, and $3.75 per sq. yd. for a bituminous-filled brick pavement on a concrete base. The total cost will be about $170,000, or $42,000 per mile; $69,000 of this is to be paid from the primary road fund, the balance to be borne equally by the county road cash fund and by donations. This project was started before the present road law went into effect so that no special assessments can be levied.

The pavement is 18 ft. wide with a uniform thickness of 8½ ins. It has a 2-in. crown and an equally crowned subgrade. The base is 5 ins. thick, of concrete proportioned 1 to 3 to 5. A ½-in. sand-cement cushion, protioned 1 to 4, is used and 3-in. vitrified brick without lugs, filled with bituminous filler, completes the pavement.

When the work was advertised I had visions of the use of considerable industrial equipment. Old methods, however, prevailed. The situation of the road with respect to railway sidings probably made it inadvisable to invest in more machinery. The Waterloo, Cedar Falls and Northern interurban tracks lie within a few hundred feet of the road for almost its entire length. Materials were brought in over this line and unloaded on three existing sidings. Aggregates were shovelled by hand directly from the cars to wagons and hauled to the subgrade. The mixer was loaded by the use of wheelbarrows.

Construction Methods and Equipment.

All water was obtained from city mains which extend sufficient at all times to maintain the supply, and no for a considerable distance along the road. Pressure was pumping was required.

Rough grading was handled with an elevating grader drawn by a steam tractor. Bottom dump wagons were used. Both Fordson and Dart tractors were tried with the wagons, but teams proved more successful. Fine grading was completed with pick and shovel. Fills were rolled in 6-in. layers with a 1-ton tandem roller.

Concrete was mixed in a 2-sack batch Foote mixer with discharge chute. Several kinds of aggregates went into the base. About two-thirds of the work contains a 50-50 gravel mix obtained from Mason City. This material required about 5 sacks of cement per cu. yd. of gravel. The balance of the base is composed of gravel obtained from different pits in the county, and limestone from the Glory quarry, proportioned 1 to 4 to 4. This gravel contained about 18 per cent. of material retained on a ¼-in. screen, which accounts for the change in proportions.

After the concrete was placed and well spaded, it was struck off with a wooden template, cut to crown, and finished with a long-handled wooden float. As smooth a surface and as dense concrete was secured as on many concrete pavements. Curing was done by ponding, earthen dikes being thrown across the pavement at intervals of 50 to 75 ft. and the concrete surface was covered with water.

Curbing

A curb 6 ins. wide and 3½ ins. deep was built integral with the base. It was constructed in the following manner: After the base was poured, a 2 by 4 was placed on the concrete for the inside curb form. It was held away from the side form by steel spreaders and held in place by U-shaped irons passing over both side form and inside curb form. A batch of mortar proportioned 1 to 2 was then run through the mixer and deposited with a shovel in the curb form. This was well spaded and troweled to a smooth finish. Metal plates ⅛-in. thick were used to divide the curb into sections about 10 ft. long.

The Cushion

After the base was thoroughly cured, the cement-sand cushion was placed. The sand was hauled and dumped and mixed dry with the cement in a small drum mixer. This was distributed with wheelbarrows, spread with shovels to a thickness of about ¾-in. and struck off to a thickness of ½-in. with a wooden template drawn by horses.

Applying the Filler

The brick, which had been piled along the shoulders, were then placed and inspected. Culls were replaced with good brick and the surface swept clean and rolled. A 4 to 6-ton tandem roller was called for in the specifications, but it was found that many of the brick were broken by the roller, and accordingly a 3-ton, horse-drawn roller was substituted. After being rolled, the surface was again swept clean and sprinkled. It was neces-

sary to wait until the brick became thoroughly dry before the bituminous filler could be applied, otherwise the filler failed to adhere to the brick. The bitumen was heated in a large kettle to 450 degrees F., distributed in pails and squeegeed into the joints. A ⅛-in. layer of sand was then sprinkled over the surface, forming a bitumen and sand surface over the brick from 1/16-in. to ⅛-in. thick.

Procedure in Cold Weather.

Work continued until after cold weather began. In fact, some brick were laid only a few days before Christmas. In cold weather it was found necessary to sprinkle the cement-sand cushion before laying the brick in order to keep the cushion from freezing. It also became necessary, at times, to heat the brick before applying the asphalt filler. For this purpose a surface heater was used. This consisted of an iron cover about 5-ft. square, the edges fitting down closely over the pavement surface under which gasoline flames burned. The results were satisfactory when the brick were covered only by a light frost or a very light snow, but when the joints were filled with ice, it could not be melted without injuring the brick.

This road has been visited by a great number of road officials from this and other states, who have been unanimous in pronouncing it one of the very best pavements they had ever seen.

Inspection

Inspection was in charge of Resident Engineer E. A. Zack of the Highway Commission. At the start, he was given an instrument man and was expected to secure such additional help as needed from non-technical local men. This plan proved satisfactory for rodmen and helpers, but after a short trial, non-technical inspectors were replaced by those who had received special training. The party was supplied with a car, transit, gravel screens and such other tools and materials as were needed. In addition, the work was looked over every 10 days or 2 weeks by a representative of the U. S. Office of Public Roads, and by the Construction Engineer and the Division Engineer of the State Highway Commission.

Slope stakes and finish stakes for grading, tile stakes and curb stakes were set by the inspectors. Curb stakes were set 1 ft. outside the edge of the pavement and blue-topped or marked to even tenths of a foot. Stakes were also set and quantities figured for borrow pits.

One man was stationed at the mixer watching proportions, consistency, subgrade, alignment of forms, finishing and curing, and checking up the amount of cement used. Cement was then measured in sack and aggregates in wheelbarrows.

A second inspector looked after the brick work, directing the mixing and placing of the cement-sand cushion, placing of the brick, sprinkling, cleaning and pouring of the asphalt filler.

Ten brick from every third or fourth car as received and a composite sample from a half dozen sacks in each car of cement were forwarded to Ames for complete tests by the State Highway Commission. Samples of gravel from several pits were also sent to Ames for analysis. So much time elapsed before reports were received on many of these tests that the materials had already been incorporated in the pavement. For example, when the reports were received a sample of gravel was sent to Ames about June 1. This gravel was some that the owner hoped could be used, and he was anxious to have it tested so that if it proved satisfactory the contractors could figure on using it. The report of the test came the latter part of July, about a month late. I understand that the commission has made arrangements to remedy this situation, and during the present year will provide testing apparatus either on the work or in the district offices to relieve any anxiety as to the quality of materials to be used. I will say that so far as I know none of the tests showed very serious defects in any of the materials.

Monthly Estimates and Reports.

The resident engineer made up monthly estimates of the work completed and materials delivered, which were paid for by the county or state. These claims are subject to considerable red tape before the contractor gets his money. They are sworn to by the contractor, checked and approved by the district engineer, allowed by the county board, checked and approved by the Highway Commission and finally checked by the Auditor of the State and warrants drawn.

An extensive system of reports was prepared by the resident engineer. There was first a daily report showing the time distribution on all parts of the work, the amount and location of the work. From this a weekly progress report was made up and forwarded to the commission. There were also various reports on materials received, samples taken for tests, and other items. Complete data were also filed on engineering and inspection work and costs.

The work was closely, and I believe, fairly inspected. Good materials properly proportioned and first-class workmanship were insisted upon. Through the combined efforts of the contractor and the engineers, a first-class pavement was built. We are proud of it, and invite engineers to come to Waterloo and see it.

The foregoing paper by Messrs. Zack and Fischer was presented before the recent annual meeting of The Iowa Engineering Society.

THE MODERN HIGHWAY SYSTEM OF BUNCOMBE COUNTY, NORTH CAROLINA

By N. Buckner, Secretary of Board of Trade, Asheville, N. C.

Buncombe County, North Carolina, of which the widely-known city of Asheville is the county seat, is one of the best paved counties in the South. It is one of the chief centers of the movement for hard surfaced highways which has already been productive of much good throughout the South. In round numbers Buncombe County has $800,000 worth of paved roads, with 31 miles now under construction. This mileage will be completed in the spring and summer of 1920 and will make a total of 163 miles, paved at a cost of $2,000,000, in addition to $554,000 worth of bridges, most of which are concrete and steel.

In addition to the improved roads in Buncombe County, and to those already built in western North Carolina, the State Highway Commission now has projected 264 miles of hard roads, every mile of which leads, directly or indirectly, to the city of Asheville. A sum of nearly $2,000,000 is now available for highway improvement

work in the western district of the State which includes 22 counties. This sum includes the federal aid, state aid and funds appropriated by counties to augment state and federal aid. This amount will be spent on the following highways: Central, Asheville-Charlotte, Asheville-Brevard, Asheville-Murphy-Atlanta, Asheville-Burnsville,

FIG. 1. ASHEVILLE-WILMINGTON-CHARLOTTE HIGHWAY, 18 FEET WIDE, CONSTRUCTED OF TEXACO ASPHALTIC CONCRETE OVER WORN-OUT MACADAM BASE.

Spruce Pine, East Tennessee and Southwest Virginia, Boone Trail and Blowing Rock highways; all of which lead to the eastern branch of the Dixie Highway system from Mackinaw south through the great grain and cotton belts, and the wonderful mountain section of Kentucky, East Tennessee and the famous "Land of the Sky" in western North Carolina, which is eastern America's climax in altitude and scenic grandeur.

Paving on Dixie Highway

The Dixie Highway crosses the Tennessee state line seven miles west of Hot Springs, North Carolina, and is paved across the county, a distance of 28.3 miles, with the exception of 2.3 miles which are heavily gravelled on the western side of the county. Approximately 14 miles of this is asphalt macadam, 2 miles of brick and 10 miles of concrete. The 10-mile stretch of concrete south of Asheville to the Henderson county line was completed in May, 1919, the work continuing through the period of the war. The city of Hot Springs, previously mentioned, was used as a camp for about 3,000 interned Germans during the war.

The secretary of the Asheville Board of Trade, and T. W. Howerton, County Road Engineer, made a special trip to Washington and showed, to the satisfaction of the War Industries Committee in charge of the distribution of Portland Cement, that the completion of this 10-mile concrete road was really a war necessity, in that it connected Asheville, where were located U. S. Army Hospitals for wounded and gassed soldiers, and Camps Green, Wadsworth, and Jackson, 60, 70 and 180 miles distant, and on direct lines to the camps at Augusta and Atlanta.

This concrete road is 20 ft. wide, 7 ins. thick in the center, tapering to 5 ins. at each side. The cost of constructing this road, which before the war started was around $18,000 a mile, had increased when the road was finished in May, 1919, to around $25,000 per mile.

In addition to 150 miles of hard surface roads in Buncombe County, there is approximately 800 miles of well-graded, top soil surface roads good for automobile traffic during eight to ten months of the year.

Some detailed information as to the cost of various kinds of roads follows: 19 miles of concrete cost $406,464.26; 26.7 miles of asphalt over old macadam road cost $339,999; 16 miles of waterbound macadam cost $133,000; and 70 miles of sand clay road cost $183,000. The cost items were kept for these particular lengths of road, part at pre-war prices and part at war prices.

Approximately $150,000 worth of reinforced concrete bridges have been built over the French Broad river above and below the city of Asheville to replace steel structures washed away by the unprecedented high water of July, 1916. The larger bridges constructed across the French Broad river mentioned in the following table, were all constructed since "the flood" except the West Asheville concrete bridge:

	Length in Feet	Cost
Craggy, Overhead Bridge (concrete)	650	$59,000
Pearson's Bridge (concrete)	400	19,000
Smith's Bridge (concrete)	500	33,000
Long Shoals Bridge (concrete)	250	10,000
West Asheville Bridge (concrete)	740	71,000
Alexander Steel Bridge	350	14,000

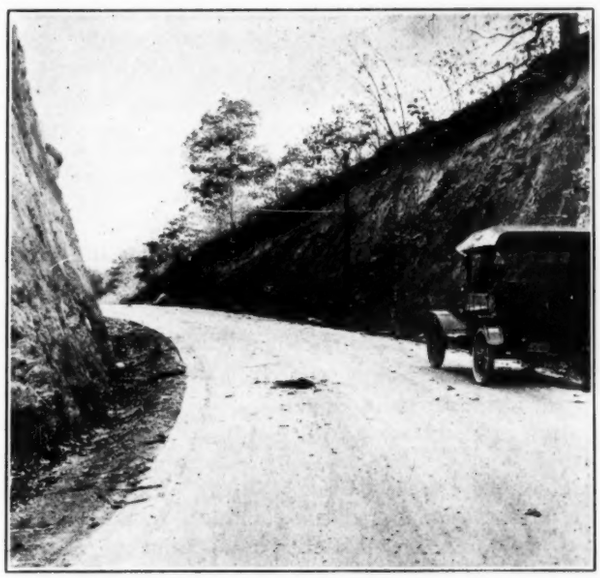


FIG. 2. ASHEVILLE-WILMINGTON-CHARLOTTE HIGHWAY AT MILE HOLE GAP, NORTH CAROLINA.
This is also an Asphaltic Concrete Highway over old Macadam.

In addition to these large bridges, built at pre-war prices, and worth twice as much now, quite a number of smaller concrete and steel bridges and concrete culverts have been built on the main arteries of travel in Buncombe County. The total cost of all bridges in the county is $554,402 with the cost of steel bridges totalling $54,620, and wooden bridges including those with I-beams $24,250.

County Has Commission Form of Government

Buncombe County has commission form of government with three commissioners giving full time to the handling of the affairs of the County. The present Board of County Commissioners consists of: B. A. Patton, Chairman and Commissioner of Finance; Otto Israel, Commis-

sioner of Public Highways, and G. F. Stradley, Commissioner of Public Institutions.

Convict Labor Employed

Convicts from the superior court of the county and the Asheville Police Court are used for work on the public roads and are handled in well equipped, permanently located sanitary camps, and are taken to work in a big White truck every morning and returned to the camp in the afternoon. The camps are all lighted with electricity and have every sanitary convenience. The men are given an abundance of wholesome food. The county authorities feed the garbage to hogs at each camp. One or two

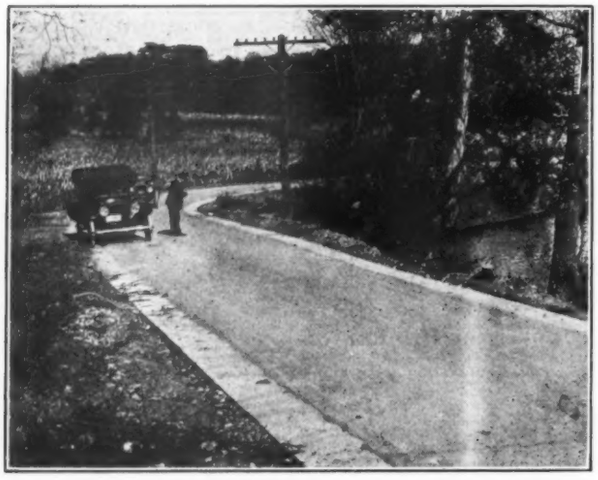


FIG. 3. CENTRAL HIGHWAY BETWEEN ASHEVILLE AND MOORHEAD CITY, NORTH CAROLINA.
Built of Texaco Asphaltic Concrete over old Macadam.

cows are kept to provide cream for coffee and milk for cooking purposes. This method has proven quite economical; it improves food qualities, and adds a touch of farm life for the unfortunate men in the camp.

County Owns Quarries and Road Machinery

The county owns three quarries and a full complement of road machinery and equipment. The quarries are located on a spur track of the Southern Railway, and the crushed stone can be loaded for shipment to the various points in the county on the railroad. Cars of crushed stone are occasionally sold in commercial channels at the usual profit. A recent audit shows value of road machinery at $37,500, auto trucks and teams at $14,750, and quarries and land at $7,500.

THE NEW BUILDING ZONE ORDINANCE OF PORTLAND, OREGON

By Charles H. Chency, Consultant, City Planning Commission, City Hall, Portland, Ore.

A comprehensive building zone ordinance has been adopted by the city of Portland, Ore. (population estimated at 320,000), which it is believed will do much to foster industry, stimulate home ownership and contented home conditions for industrial workers, as well as make the city a more comfortable, orderly and convenient place for all who live and work here. This ordinance was the result of some 18 months of careful study and more than 150 meetings and conferences by the City Planning Commission and the neighborhoods and property owners affected in all parts of Portland.

Use of Data Maps

Complete use of property maps and other data maps were prepared, showing the existing conditions and tendencies of growth of the city. These were carefully discussed by representative property owners' committees in each neighborhood who, with the aid of the City Plan Commission, evolved a preliminary zoning plan, which was ratified at a neighborhood meeting, to which all property-owners of the district were invited. These neighborhood plans were later pieced together to make up the general preliminary zoning plan for the city. After public hearings during a number of months, before both the City Planning Commission and the City Council, the ordinance was finally adopted in its present form on March 17, 1920. It will be subject to a vote of the people at the general election next November.

Benefits Expected

In its final report to the City Council the City Planning Commission said that it was to be expected that this ordinance would benefit the city as follows:

1. Stabilize and protect property values and investments.
2. Protect the maintenance of the home and of home neighborhoods.
3. Offer a safe district in which industries may be located without fear of protest and with every facility to do business.
4. Prevent undue congestion of population.
5. Insure better sanitary conditions.
6. Simplify the problem of street traffic regulations.
7. Make possible a sensible and more practical street paving program for the future.
8. Render possible great economies in the paving of city streets through a decrease in the width of roadways, where sizes and number of buildings are limited.
9. Insure the permanence of character of districts when once established, permitting and encouraging orderly enlargement of business centers and industrial zones while preventing the scattering and intrusion of any inappropriate and destructive uses of buildings which deteriorate and decrease property values; and, finally,
10. Make Portland a more orderly, convenient and attractive place in which to live and work.

The new Portland zone ordinance combines the principal protective features of the Alameda, Los Angeles, St. Louis and New York zone ordinances. It applies to new building permits only, existing buildings and uses not being affected, even though they fall outside the respective zones proper for them.

The Use of Property Regulations

It was found necessary to establish eight kinds of classes of use districts. These comprise two kinds of residence classes—Class I, for single family dwelling primarily, and Class II, for any kind of dwellings, including flats, apartments and hotels; two kinds of business classes —Class III, for ordinary retail stores, offices and dwellings, and Class V, for all kinds of retail, wholesale and other business, except industries, including dwellings; two kinds of industrial districts, Class VII, for all ordinary non-offensive industries and business, and Class VIII, for the odor and smoke-producing plants; and two

special classes of use districts—Class IV for public and semi-public buildings, parks, etc., and Class VI for hospitals, charitable homes, etc.

At present it was decided that there should be no Class VIII districts within the city limits, a large industrial area for stock yards and similar industries already being well established outside the city limits to the north, where prevailing winds will carry away offensive odors and smoke. There are, therefore, really only seven classes of use districts established at this time, which may be more particularly described as follows:

Classes of Use Districts

Class I resident districts will permit new single family dwellings, churches or schools only. Approximately 85 per cent. of all buildings in Portland today are single family dwellings, and the City Council has now set aside about two-thirds in area of the whole city for Class I districts to protect homes at the request of property-owners.

Class II residence districts, permitting any kind of new dwelling, flat, hotel or apartments, were established around the central core of the city and in numerous small districts through the outlying sections. Buildings of this type actually cover today an aggregate of about 250 blocks (200 ft. square) throughout the city. The zone ordinance establishes 1,250 blocks in Class II, beside permitting this type of buildings in over 800 more blocks of business districts of Class III and Class V. It is estimated that this allows apartment house space enough to take care of Portland's needs in this type of buildings until the population exceeds a million and a half.

Class III business districts, for all ordinary stores, trades and professions, including any kind of dwellings of Classes I and II, were established to cover the downtown retail center and a number of retail centers which desired to keep out the public garage and other businesses which interfere with the best retail store development.

Class V business districts, permitting any kind of new retail or wholesale business, warehouses, public garages, dyeing and cleaning establishments, undertaking parlors, etc., were established surrounding the downtown retail center, and at practically all existing local business centers at cross roads, about every half-mile conveniently located, through the outlying residence districts, and on practically all main traffic arteries.

Class IV districts, for public and semi-public buildings, schools, churches, playgrounds, parks, airplane landing fields, libraries, fire houses, greenhouses, etc., were established to cover every existing property of such use in the city.

Class VI districts, for hospitals, sanitariums, clinics, day nurseries, homes for the aged or children, and other charitable institutions, were established to cover existing institutions of this type that the surrounding neighborhoods would agree should be permanently located there. In a few cases where good home neighborhoods had been invaded by such institutions, the property-owners vigorously protested against making them permanent, and these will either have to seek a new location or convince their neighborhoods before they can be enlarged.

Class VII industrial districts, for all ordinary, not obnoxious, industries, warehouses and factories, including any business use, but excluding new residences of any kind, were established to include approximately 6,000 acres within the city limits, in which practically all such existing properties are today located.

No new residences are to be permitted in the industrial districts, as in Alameda, Newark, etc. The small residence owner fights improvements that industries must have in the way of wide, heavy-hauling pavements, extra large sewers, unlimited spur tracks, closing of streets, etc. Plants desiring housing sites for employes adjoinings their works can have that portion of their property reclassified in one of the residence zones.

Limits on Heights of Buildings Established

To protect the city from overcrowding at a few points and from scattered overhigh structures, limits on the height of new buildings are established in the ordinance, with appropriate regulations to meet the needs of the different use districts. The following height districts were established:

The 2½-story height districts, limiting new buildings to a maximum of two stories and finished attic, not to exceed 38 ft., were established to cover the outlying single family residence districts of Class I. It was found that 97.5 per cent. of all existing buildings in the city are of 2½ stories or under, and it was thought advisable to maintain this character of homes for the best interest of both home owners and the city.

The 3-story height districts, limiting new buildings to 3 stories or not more than 42 ft. in height, were created to cover nearly all the small outlying business and apartment house districts.

The 4-story height districts, including new buildings to 4 stories or not more than 60 ft. in height, were made to cover the apartment house and business districts just away from the center of the city.

The 6-story height districts, limiting new buildings to 6 stories or not more than 85 ft. in height, were established to cover the closer-in apartment and business centers, except the central downtown district.

The 8-story height districts were established limiting new buildings to 8 stories or 105 ft. in height in the industrial zones and in the wholesale districts in the center of the city.

The 10-story height districts, with a limit of 130 ft. in height, were established for the central downtown retail district only. A few buildings of 14 and 15 stories already existed in this district and the testimony of the assessor and owners of property was that they were not profitable, aside from the fact that they cast a shadow, cutting off light and air from their neighbors. These downtown regulations were the result of many months' study by a representative committee appointed by the Realty Board and Building Owners' and Managers' Association.

Towers, gables, spires, grain elevators, gas or water tanks can exceed the height limit provided they set back 1 ft. for each additional foot of height above the height limit and do not cover more than 2,500 sq. ft. on the base area.

Area Requirements

In business and industrial districts rear yards are required, but only where windows necessary for light and air are opened at the back of the building. Portland already has a housing code pretty well protecting dwellings, apartments and hotels. In the Class I single family dwell-

ing districts property owners asked to have their neighborhood kept as open as at present and accordingly home area regulations were established to cover all Class I districts, requiring new dwellings to cover not more than 40 per cent. in area of the lot at grade nor more than 30 per cent. in area of the lot above a level above 16 ft. above grade. It was found that practically all the homes in these districts at present cover only from 20 to 25 per cent. of the lot and that therefore this regulation would not prove onerous. It is similar to the requirement of the Class E area districts in the New York City zone ordinance.

Flexibility and Method of Amendment

The importance of a reasonably simple method of amendment was much emphasized in preliminary discussions on the zoning ordinance and as finally passed it is arranged that any property owner, upon filing a list of all owners within 200 ft. of the property desired to be reclassified, can set in motion the machinery for bringing about a change. The matter is then automatically referred to the City Planning Commission for report, and upon receipt of this report the auditor shall within not less than 12 days set a hearing before the City Council, notifying all property owners within 200 ft. The action of the council is then final, and the whole proceeding can be accomplished in a week's time if special occasion requires it. It was realized that no zone ordinance can be perfect, and any such instrument must be a living and growing thing if the city is to progress. While the tendencies of city growth under zoning will undoubtedly be to maintain the business and industrial centers as established, enlargement from time to time of their boundaries and of the apartment house, or Class II, zone is to be expected to keep up with the normal increase of the city.

Importance of Zoning at This Time.

The importance of the adoption of a zoning plan by Portland is evident at this time, as the city is undoubtedly entering upon an era of great expansion, in addition to having to catch up for five years of lack of building during the war period. It was urgent to have some sound basis for settling where the industrial districts are to be and where the facilities for them can be concentrated. This the zone ordinance will do, as well as establish safe, protected home neighborhoods near industries for the housing of industrial workers.

Bidding for New Industries

Competition has become an important factor between Pacific coast cities hoping to secure new industries. It is well known that some dozen or fifteen of America's largest industries are getting ready to locate coast branches. Alameda, Berkeley and other cities have already established industrial zones, where greater facilities and privileges are being concentrated than obtainable elsewhere. Seattle, Tacoma, Spokane and San Francisco all have zoning commissions at work, each trying to make ready to attract these great payrolls. Portland seems so far to be ahead of them, if certain reactionary forces within the city do not prevail.

The city's industrial commission, or Committee of Fifteen, as it is called, has brought forward a most important plan for the improvement of the harbor at a cost of $10,000,000, bonds for which will undoubtedly be voted in November.

The Building Trades Council and most of the lending institutions of the city urged the passage of the zone ordinance as an encouragement to building. They pointed out that many owners were now afraid to build for fear of what might locate next to them and prove a detriment. Zoning will give a sense of security and a solid foundation for investments to poor men and rich men alike, not heretofore possible with unregulated growth.

Evidence of the Experience of Other Cities with Zoning

During the discussions on zoning before the Portland City Council question was raised as to exact evidence on the experience of cities that had already adopted zone ordinances. It is interesting that we were able to discover no city that had abandoned zoning after once trying it out. Nearly every zoned city has found it necessary to amend and readjust boundaries from time to time, but this we take as an evidence of progress.

Mayor George L. Baker wired the mayors and realty boards of a number of the principal cities of the country, and the following replies are of value as current opinion only:

Oakland, Cal.—"Oakland has had zoning ordinance in effect since April, 1915. Results satisfactory to everyone."

Los Angeles, Cal.—"We have zone ordinance protecting business and homes, working satisfactorily."

New York City.—"New York zoning ordinance enacted July, 1916. It has met universal approval. It has protected business and residence property. In some residence sections decline has been stopped and important improvements made. Other residence sections have been much enhanced in value. The height, area and use provisions have all been of value. I wish we might have passed an ordinance 50 years ago. It could have been much better and would have saved great loss."

St. Louis, Mo.—"Our zoning ordinance in effect since August, 1918. It has protected residential districts from invasion of inappropriate structures and seems to have general approval. We have had to make some amendments to the original ordinance to meet the requirements of St. Louis's large industrial expansion during the past year. The zoning ordinance should meet with great approval, but should be sufficiently elastic to meet changing conditions."

Alameda, Cal.—"Zoning ordinance protecting industries, business and homes in effect just one year. Already we see beneficial results, especially in regard to protection of homes and business. Too early to say much about assessments, but we believe this ordinance will tend to stabilize them. General satisfaction expressed throughout the city."

Minneapolis, Minn.—Minneapolis Real Estate Board is a unit in believing that zoning conserves real estate values and promotes an economical and logical growth. We are trying to obtain a zoning plan for Minneapolis. At the present time we have succeeded in getting a law providing for a city-planning commission, but due to opposition of short-sighted members of our city council it is not as yet functioning. We have already, under a law adopted in 1915, established a large number of residential districts, but this is proving a poor substitute for a comprehensive city plan, and many residential neighborhoods, consisting of modest homes, as well as fine homes, are

being destroyed by incursions of apartment houses and stores. Minneapolis is going to have a comprehensive zoning plan if it has to elect an entirely new city council to get it."

Chicago, Ill.—"Common Council of Chicago today (Feb. 18, 1920) unanimously approved building zoning ordinance proposed by Cook County Real Estate Board. We believe comprehensive zoning regulations give stability to land values and prevent commercial depreciation of building values. We expect our regulations greatly to enhance total valuations of real estate in Chicago."

New York City.—"Real Estate Board of New York has followed zoning plan since inception and sat in conference with framers of original regulations. Helped upholding constitutionality. Majority public sentiment here approves zoning plan and general effect is undoubted stabilization of values and rents. Wartime restriction of building retarded operation of law, but regulations are working out systematically."

St. Louis, Mo.—"The zoning regulations adopted two years ago are not popular with many real estate agents, since they prevent the indiscriminate sales of vacant lots for every use. They have considerable merit in this, that they prevent the invasion of apartments or business buildings in residential districts. I am not of the opinion that they stabilize values or help conditions; our zoning regulations are not elastic enough in this, that no change can be made in certain districts without the consent of a majority of the property owners."

HOW TO SECURE A BETTER STREET LIGHTING SYSTEM AT A REDUCED EXPENSE

By Frank Koester, Consulting Engineer and City Planning Expert, 50 Church Street, New York, N. Y.

All municipalities face the problem of raising taxes to meet the ever-increasing yearly budget. This is caused in no small degree on account of the losses sustained, due to the dry laws. Cities with a population of 50,000, for instance, lose as much as $100,000 per year in revenue, and as city employees receive higher salaries (at least they should) due to the increased cost of living, and as all new municipal construction work is at least 50 per cent. higher than it was before the war, it will be seen what efforts cities must make to meet the yearly bill.

In the present article I am outlining a plan whereby a community may save many thousands of dollars yearly on a single item of the budget. It is the municipal lighting whether operated by the city or by a privately owned local light company.

From an engineer's point of view, it is simple. However, considerable handicap, if not failure, may be met, if the plan is not scientifically prepared and presented in proper shape.

The nitrogen filled Tungsten lamp consumes one-half of the amount of electric current as the various types of arc lamps so much used throughout the country; while the common incandescent lamp consumes about one-quarter more current than the first mentioned lamp. Herein the plan of saving is indicated.

Due to the fact that many city officials hold their positions due to political favors, many administrations will not dare to "buck up" against the local light company, which, as a rule, is connected directly or indirectly with the trolley company. The latter, within recent years, has been demanding higher fares, claiming that otherwise they will be forced into bankruptcy.

Once in a while there is a city official with sufficient independence to introduce a resolution calling for an investigation of the street lighting system. Such were the cases before the writer was retained by some cities in Pennsylvania.

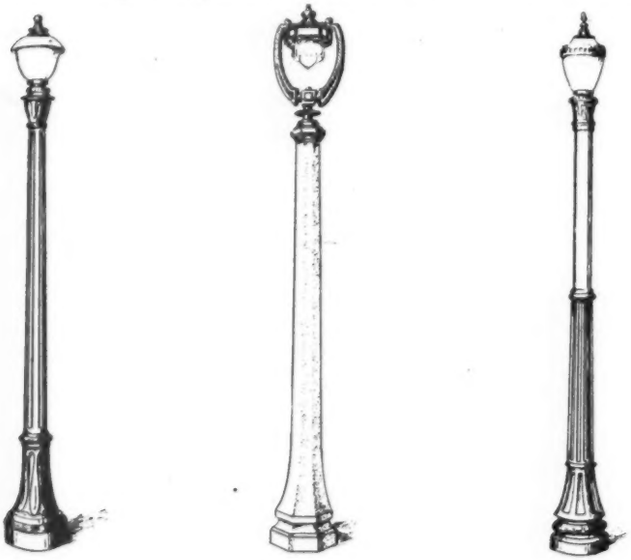
My investigations in these cities also covered the financial aspects of the electric companies in the respective cities, and it shows that the trolley companies' claims for increased fares are not always warranted. For instance, in one city the local light company, which previously was an independent concern, is now "owned" by the traction company, which had a net earning of 32 per cent. in 1917, the very year when this company demanded increased fare and ever since has received 7 cts. instead of 5 cts., the old-time fare. This latter company is "controlled" by another out-of-town corporation, which had a net earning of 41 per cent., and this latter corporation is "under the management" of a New York corporation which had a profit of 54 per cent. and, again, this latter

VIEWS OF HAMILTON AVE. AT SIXTH STREET, ALLENTOWN, PA., BEFORE AND AFTER REMOVAL OF SIDEWALK OBSTRUCTIONS.

organization is "controlled and all common stocks are owned" by a big manufacturing corporation.

Now, it is known that within recent years, the earnings of a trolley company are not as good as that of an electric light and power company. Therefore, the light company in question had to support the trolley company at the expense of electric current consumers. And as the trolley company is being "controlled," "managed" and "owned" by three different outside corporations, it will be seen that the consumers of electric current must foot the bill.

Another problem of the city officials, who handle the taxpayers' money for street lighting, must be met if they are aware of the following facts. A large number of local electric companies are practically forced to buy all their needs from the manufacturing company which "controls and owns all common stock" of the "managing" and "controlling" companies, as stated above. This means



THE HEIGHTH OF POST DEPENDS DIRECTLY ON THE CANDLEPOWER OF LAMP AND EQUALLY AS MUCH ON THE TYPE OF GLOBE OR REFRACTOR.

that the local electric company must buy at the prices of and from this particular manufacturing company, and if such a manufacturer produces globes for street lamps, these globes will have to be installed regardless of the cost and efficiency of the globe.

Now, 50 per cent. of the illuminating effect in street lighting lies in the globe or reflector. My tests show tha a 250 candle power nitrogen lamp with a certain globe gives a very much better illumnating effect than a 600 candle power nitrogen lamp provided with another type of globe. This, as well as the height of the lamp, above street surface, is a very important factor to be taken into consideration. If a boulevard lighting is to be installed, the design of the posts to harmonize with the surroundings and their spacing are other not to be neglected considerations.

Many electric companies demand higher remuneration for their service, claiming higher cost of producing electric current, etc. These companies as a rule advance the argument that coal and labor are about twice as high as they used to be. This is true; but with skillful engineering, the final cost per kw.-hour generated is not much higher, if any at all, than it used to be 10 or 20 years ago, because the efficiency of the power plant as a whole is about twice as high as it used to be. Today nearly twice as much steam as then is being generated per pound of coal, and while the prime-movers used to consume 25 to 30 lbs. per kw.-hour, today they consume but 14 to 16 lbs.

Conditions in Allentown, Pa.

While the foregoing various facts were recognized by the city officials of Allentown, Pa., the city retained my services to make an investigation of their street lighting system.

The city of Allentown, Pa., for the year 1918 paid the local electric company for services rendered $49,635. For 1919, it was $51,066 for street lighting and $2,200 for lighting the various mnuicipal buildings, or a total of $53,260. At 4½ per cent. interest, this yearly payment represents a capital of $1,183,600.

This report shows that for a municipally owned system, a capital of $155,206 is required, while the yearly total operating cost, including interest on the capital and depreciation of the entire system, with coal at $4 per ton, will be $36,866 and with coal at $5 per ton, $40,853. Therefore, a yearly saving of from $12,413 to $16,400 will be effected, if the city owns and operates the street lighting system, using Nitrogen filled Tungsten lamps of the same candle power as the present arc lamps. The city could pay off all the borrowed capital within 10 to 15 years.

While Allentown in 1916, according to my City Planning Report of 1915, installed on the main business streets a boulevard lighting system of single lamp ornamental posts (14 per 430 ft. block. or 7 on each sidewalk), in the rest of the city, the old arc lamp was retained. This is a 4 ampere series type lamp, and, while it consumes 320 watts, my tests made (with newly calibrated standard instruments), showed that the candle power was, at best, but 249.3 candle power; that is, when the arc lamp was specially prepared for the test and provided with new carbons and a new globe while it was generally believed to be 800 candle power. This latter figure, however, was "nominal" candle power, and this, in modern science means anything and nothing. The fact remained that these arcs were actually not quite 250 candle power under the most favorable conditions, and for this reason a calibrated Nitrogen filled Tungsten lamp of 260 candle power (manufacturer's rating 250 c. p.), was selected as a standard for comparison. The light value of the arc lamp at 20 ft. distance was 87.5 per cent. and at 70 ft. distance, it was 95.9 per cent. that of the Nitrogen lamp. The Nitrogen lamp was provided with a Holophane refractor, while the arc lamp had a new clear glass single globe. In addition the former lamp gave a steady light while the latter, as all arcs do, gave a very unsteady light.

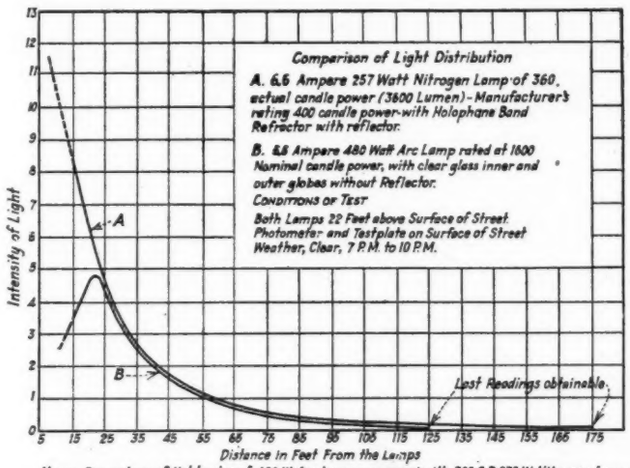
After this report was handed by the city to the local electric company, that company offered to install free of charge the lamps proposed and charge per lamp $40 instead of the $64 the company was getting for the antiquated arc lamp.

Conditions at Scranton, Pa.

Due to the results obtained in Allentown, the city of Scranton retained my services to make a study of their

lighting system and the results of the study are as follows:

The city has at present 1,286 arc lamps of 6.6 amperes and 480 watts, which cost the city $50 per lamp per year, and 77 Tungsten lamps of 80 candle power (100 watts) at $15 per year. In addition, current is being used in some 40 municipal buildings for light and power. The cost for light is 10 cts. for the first 150 kw. hour, 9 cts.


Comparison of Light Distribution
A. 6.6 Ampere 257 Watt Nitrogen Lamp of 360 actual candle power (3600 Lumen)-Manufacturer's rating 400 candle power with Holophane Bond Refractor with reflector.
B. 6.6 Ampere 480 Watt Arc Lamp rated at 1600 Nominal candle power, with clear glass inner and outer globes without Reflector.
CONDITIONS OF TEST
Both Lamps 22 Feet above Surface of Street
Photometer and Testplate on Surface of Street
Weather, Clear, 7 P.M. to 10 P.M.
Intensity of Light
Distance in Feet From the Lamps
Last Readings obtainable
A
B

NOTE: Percentage of light value of 480 W. Arc Lamp compared with 360 C.P. 275 W. Nitrogen Lamps 97.44%, 65.19% and 25.81% at 25, 75 and 125 Ft. respectively. Therefore, Arc Lamp under most favorable condition (25 Ft.) indicates 350.8 C.P.; at 125 Ft. it gave 20% less light than the Nitrogen Lamp at 175 Ft. Arc Lamp very unsteady light with dark spot below lamp. Nitrogen lamp steady light with bright spot below Lamp

CHART NO. 1. RESULTS OF STREET LIGHTING TESTS MADE AT SCRANTON, PA., ON NOV. 2, 1919.

for the next 100 kw. hour, and 8 cts. for all in excess of 250 kw. hour. The total bill for the year ending Nov. 30, 1919, was $69,555.85. Many of the municipal buildings receive current free of charge, and if figured on the above basis this amounts to $10,687.53.

The tests made on the 480 watt arc lamps which were specified in the contract made 10 years ago as 1,600 nominal candle power, proved them to be, under the most favorable conditions, but 350.8 actual candle power. A 400 candle power (manufacturer's rating) Nitrogen lamp, when calibrated in a testing laboratory, was found to be 3,600 lumen or 360 candle power, 257 watts and was used in the comparative tests as a standard and set down as 100 per cent. It proved that the percentage of light value of the 480 watt arc lamp, compared with the 360 candle power, 257 watt, Nitrogen lamp was 97.44 per cent., 65.19 per cent. and 25.81 per cent. at 25, 75 and 125 ft. distance, respectively. Directly beneath the arc lamp, as with all arc lamps, was a very dark spot, and it was very difficult to make the first readings at 15 ft. distance on account of the great fluctuation which is more noticeable at close range; while the Nitrogen lamp gave an intense uniform light.

With the arc lamp at a distance of more than 125 ft., no further readings could be made with the instrument, while with the 360 c. p. Nitrogen lamp, the last readings obtainable were at 175 ft. distance; therefore, under the most favorable condition, at 25 ft. distance, the arc lamp, when compared with the 360 c. p. Nitrogen lamp, indicated but 350.8 candle power. As stated above, the arc lamp throughout the readings, as will be seen in the accompanying chart No. 2, gave a very fluctuating light while the Nitrogen lamp, a steady light. In addition, the arc lamp consumes 480 watts, while the 360-candlepower nitrogen lamp but 257 watts.

I wish to point out here that the arc lamp, for testing purposes, had new inner and outer globes, and in order to establish the illuminating value of an arc lamp not especially prepared for these tests, I conducted a test on such an arc lamp. It showed that this lamp had an illuminating effect of but 53.2 per cent. of the illuminating effect of the arc lamp especially prepared.

Superiority of Nitrogen Filled Tungsten Lamps

Therefore, the proposed 400-candlepower, 276-watt, 6.6-ampere Nitrogen-filled Tungsten lamp proved to be superior in every respect to the Scranton arc lamp, because—

1. It gives greater illuminating effect near the lamp.
2. It gives greater illuminating effect at a greater distance.
3. It does not require as much attention.
4. It does not produce, when fitted with a proper globe, a glaring effect, such as all arcs do.
5. It gives a constant light, instead of flickering, as all arcs do.
6. It consumes about 57.3 per cent. the amount of electric current.
7. It will save, by substituting the arc lamp with nitrogen lamps, some $25,000 per year.

Conditions in Another Case

Besides making this test, I made a study for a municipally owned lighting system, and as the gas and water supply systems are in the hands of a private concern, there was no possibility of connecting a municipal electric generating plant with these plants. But the city possesses

This line represents light value of Nitrogen Lamp taken at 100% at each point
Last Reading Obtainable
Light value of Arc Lamp
Last Reading Obtainable
Percentage Light Value
Distance in Feet

Curve showing percentage of light value of 480 Watt, 6.6 Ampere, 1600 nominal candle power Arc Lamp, compared with 257 Watt, 6.6 Ampere, 360 actual candle power, Nitrogen filled Tungsten lamp at various distances. Nitrogen lamp taken as 100% at each distance. o Circles shown the great fluctuation of arc light.

CHART NO. 2. COMPARISON OF EFFICIENCY OF ARC AND NITROGEN FILLED TUNGSTEN LAMPS.

an incinerating plant, destroying daily some 60 tons of garbage and refuse, which is collected separately by the city. If the gases of these destructors were properly utilized, from 1 to 1.3 lbs. of steam could be generated, and assuming but 1 lb., there could be generated some 120,000 lbs. of steam per 24 hours. These waste gases represent a value of $9,150, while the force at present employed receive a total wage of some $9,000 per year. This $18,000 per year is a big item in the economy of the electric generating plant. (The balance of the steam required throughout the year will be generated by crude oil or Scranton coal at a cost of $1,250 and $2,500, respective-

ly.) As the bulk of the steam is required in the night time (for street lighting), and as the garbage is being collected in day time, the plant is provided with a 60-ton storage bin.

The generating room is provided with one 200, one 300 and one 500 kw. turbo-generator set. The actual full load demand is 486 kw. when using nitrogen lamps (with arc lamps 818 kw.). The 11 electric circuits are to be fed from this plant and are overhead, with the exception of the part in the business or fire districts, where also an extended boulevard lighting system of some 400 single lamp poles (10 to 14 lamps per block, or 5 to 7 lamps on each side) is provided.

The yearly cost for maintaining the boulevard lighting is nearly $13,000, and as the total savings as above stated, is about $25,000, there may be installed throughout the city in addition 200, 100 c.p., 100, 250 c.p. and 100, 400 c.p nitrogen lamps and still leave a few thousand dollars for other purposes.

With the above described plant it will cost the city of Scranton 1c to generate 1 kilowatt hour and it will cost another 1¾c (including line losses, etc.) to bring the current to the point of consumption. (The high cost for distribution is due to the exceptionally large area of the city, namely, 25 square miles for a population of some 160,000.) In other words, should the city decide to sell current for light and power to private consumers, in which case a larger power plant would be required, and, therefore, the production of electric current would be correspondingly lower per kilowatt hour, while the distribution system would remain practically the same, figuring a net profit of 10 per cent., current could be sold at an average of 3 cts. per kw. hour, while at present the charges, as stated above, are 8, 9 and 10 cts.

Many Pennsylvania cities, recognizing the great advantage obtained in possessing a modern street lighting system, including boulevard lighting for the business streets, as a part of an efficient city planning program, are at present busy substituting the old-time arc lamp with the more efficient Nitrogen-filled Tungsten lamp. For instance, the city of Bethlehem, for which I made a comprehensive city-planning report in 1919, is now installing a boulevard lighting system of some 250 ornamental single lamp posts. The neighboring city, Allentown, installed within a year after I had made a city-planning report a boulevard lighting system of some 160 lamps on Hamilton street, which is the main business thoroughfare. Since then additional business streets have been provided with the same lighting standard. These posts are provided with flower bowls; the maintenance of the latter is about $2,000 per year. The cost of the flowers in summer and green plants in winter time is, per bowl, $2 and $1 per year, respectively.

A feature very much overlooked in boulevard lighting is the adoption of the height of a lamp post according to the candlepower of the lamp and to the kind of globe or refractor. As a rule the lamp posts are far too low for the candlepower of the lamp used; and, without going into detail, it may be stated that (if it were possible) one lamp for the entire city, like one sun for the entire world, would establish an ideal illumination.

WIDTHS AND LOADINGS FOR HIGHWAY BRIDGES*

By Lewis M. Gram, Professor of Structural Engineering, University of Michigan, Ann Arbor, Mich.

It is not so many years ago that practically all of the engineering advice relating to the purchase of highway bridges of a permanent character was furnished directly or indirectly by steel fabricators who were interested in that class of business. The specifications were uniformly simple, and little engineering collaboration was required on the part of the purchaser. The length and width were usually specified, and the capacity expressed by a uniformly distributed load as 80, 100 or 125 lbs., with a factor of safety of 4 or 5, as the case might be. In a paper read before this course a few years ago, the author discussed the ambiguity and inconsistencies of such specifications and it is not the intention now to elaborate further upon the merits or demerits of the earlier methods of procedure in this connection. Suffice to say that the amazing progress which has been made in highway engineering organization in general during the past decade or two has naturally brought about radical changes in practices relating to highway structures which form such an important part of the road system. The men nowadays who make a scientific study of the highway problems in general are of the caliber necessary to handle intelligently practically all of their bridges, at least in so far as general specifications are concerned.

The author has recently taken occasion to examine some of the publications issued by the public road organizations in various states and is gratified to see in the treatment of structures the reflection of highly competent engineering counsel. In fact, in glancing through the structural specifications as embodied in the documents of such organizations as referred to, one is quite likely to note the similarity to those of well developed railway practice. And why not? The problems are much the same and certainly no one who is familiar with the situation in structural engineering fails to recognize and appreciate the competency of the engineering corps who have been instrumental in developing railway construction to its present high standard.

Loose and general specifications are no longer sufficient in the matter of highway structures any more than for those on railways, and the highway engineer must consider it part of his duty to give special attention to each and every structure which forms an integral part of his road system. Careful surveys should be made of service requirements, both immediate and future, in order that the general specifications may be prepared accordingly. To follow the railway analogy a little further, for example, the particular highway in question, with its incidental structures, may form part of a present or future main line where the traffic is, or is likely to be, heavy and frequent; or it may be a branch line where the demands are comparatively light.

Elements in the Bridge Problem.

There are many problems which the highway engineer must take up and solve at the outset concerning the de-

* Presented on Feb. 26, 1920, at the Sixth Annual Short Course in Highway Engineering at the University of Michigan.

sign of a bridge structure, of which the following more important ones may be mentioned:

1st. Type of structure.

2nd. Material best adapted.

3rd. Capacity both as to the volume of traffic which may be accommodated at one time and as to its weight.

Loading of Bridges.

The type of structure and material best adapted are decided upon after a careful study of the economic and aesthetic features of the case in hand, and it is the intent of this article merely to discuss the third problem, namely, capacity of the structure and more particularly the weight of service traffic. At the outset it is proper to note that this point, involving as it does speculation on future requirements, can be handled with least scientific certainty. All will readily agree that in hazarding a prophecy regarding the future in highway transportation one guess is as good as another. Only a few days ago an item appeared in the public press to the effect that a patrol had been stationed along one of our recently completed public highways for the purpose of preventing the passage of motor vehicles of a capacity considered detrimental to the road structure. If that report be true, here we have an example of a transportation line excessively loaded almost as soon as it is completed for service, an engineering error, if it be so considered, which is excusable only when we stop to think of the almost unbelievably rapid development of highway transportation during the past few years; and if the roadway surface is seriously impaired by excessive loading and speed, how much more dangerous is the effect upon the bridges which it is assumed are designed for the same loading as other parts of the same road division. The following paragraph, pertinent to the situation, is extracted from an address delivered by H. E. Breed at the Highway Transport Conference in New York on January 10th.

Weak Bridges.

"There is a pressing problem before all of us, upon which you should take immediate action. You all know the danger and delays caused by weak bridges. Bridges have lagged farthest behind in improvement, because they are not regarded as an integral part of the highway system. Along roads that are bearing 14-ton loads you constantly meet bridges designed for only 10 tons. In New York State there are 33,775 bridges. Of a total of 251 bridges on three main traveled routes from the Pennsylvania State line to New York City, only 115 are built for 15 tons or over; 17½ per cent. of them are built for less than a 5-ton load. Twenty-three of them would stand less than 3 tons. On the less traveled routes the status of bridges is even worse. It is as menacing in other states as it is in New York. This matter should be rectified at once by petitioning our legislatures for funds with which to bring our bridges up to required capacity. Otherwise, the progress of our whole system is threatened by its weakest link."

But it is not necessary to go all the way to New York State for example of weak highways bridges. We have them in our own midst, and why some of our structures safely carry the loads which are passing over them daily is a miracle of science which I will not attempt to explain.

What the future development in highway transportation will be no one of course knows, but there is certainly no excuse for failing to provide for present general needs in proposed highway structures, and also for making at least modest provisions for the future. It is not out of place to ask in this connection whether the highway proper and its incidental structures should not serve as a stimulus to encourage even more rapid development of transportation facilities. There are economic propositions involved, doubtless, in an answer to this question and perhaps you have already considered it from the roadway proper angle. I wish only to say here that whatever decision may be reached regarding the roadway proper, applies with greater emphasis to the highway structures, because the weakness or failure of a single structure may tie up, for a time at least, an entire section of the highway.

Very Heavy Loads.

A study of the specifications of 29 truck manufacturers recently collected by the Highway Department of the University of Michigan discloses the fact that while practically all of them are turning out vehicles weighing from 10 to 12 tons loaded, 15-ton trucks are not at all uncommon. In view of existing traffic requirements, therefore, one can hardly be criticized or considered too enthusiastic on highway transportation to predict the commercial use of motor vehicles weighing loaded as much as 24 tons, during the reasonable lifetime of a permanent structure. Some of our state highway departments even now wisely recognize the probability of continually growing traffic demands and specify design loads of that magnitude for their permanent concrete bridges.

With regard to the volume capacity of highway bridges the ever increasing widths of motor vehicles and the speed with which they are propelled is again causing radical changes in bridge specifications. Where 18, 16, or even 14 ft. was formerly considered sufficient to provide for two lines of slowly moving traffic, many vehicles are now being used on the highways which require at least 8 ft. of width and on that basis it is my judgment that 20 ft. should be provided for two lines of vehicles on bridges of the main traveled routes, and 38 ft. for four lines of vehicles.

Distribution of Concentrated Loads.

To those who are interested in the technical design of highway structures there are various interesting points to be taken into account, some of which have already been made the subject of experimental investigation and others which should be so investigated at the earliest possible date. One such point of which mention might be made is the distribution laterally and longitudinally of concentrated loads. An engineer familiar with the designing of bridge structures will appreciate that concentrated wheel loads, instead of nominal uniformly distributed live loads, usually control in proportioning members of the floor system. A study of current practice in various states shows, however, that there is a lack of uniformity in the method of handling concentrated loads, differing by several hundred per cent. It will be seen, therefore, that for the same traffic requirements a wide range of results is obtained due to varying judgment in the methods of applying concentrated loads in the design. Perhaps the most liberal and intelli-

gent specification in this connection is that of the Bureau of Public Roads.

Impact.

A second point of technical interest upon which authorities and specifications differ widely is that of impact. To what extent should the live load be increased in intensity due to the manner of its application? This is such a complex question, affected by so many conditions incident to both dead and live loads, that much experimental data will be needed upon which to base an intelligent answer for any particular type of structure. Investigations are now under way by the Bureau of Public Roads relative to the dynamic increase in weight of the wheel of a loaded truck on a road surface, showing that an increase of 2 to 400 per cent must reasonably be expected. A study of such data rather leads one to believe that insufficient importance has been attached heretofore to the matter of impact on highway structures; and it is hoped that investigations of similar nature may be made also on structures of various types.

In closing, it would seem pertinent in view of the rapidly increasing demands of traffic upon our highways, to emphasize the importance of careful supervision and maintenance of highway structures. The engineer who is entrusted with responsibility for the highways in any given district should not only know the capacity of every structure under his care, in order that precautions may be taken to avoid accident due to inadvertent overloading, but he should see to it that the period of usefulness of every structure is prolonged by proper maintenance.

CO-OPERATION BETWEEN THE ENGINEER AND CONTRACTOR

By C. D. Franks, District Engineer, The Portland Cement Association, Merchants Bank Bldg., Indianapolis, Ind.

Just what the engineer's attitude should be toward the contractor is not so clearly understood as it should be. To draw the line of demarkation between serving our own interest and that of others—to indicate clearly by that line where our service to others ceases to react to our own interest, is a delicate and difficult task, but it is apparent to those of us who have been in position to observe that a far greater service than has been rendered could be rendered by the engineer to the contractor without touching that line or transgressing in any respect. Such service to the contractor, comprised of engineering knowledge and technical assistance, would reflect invariably to the credit and interest of the engineer, said Mr. Franks in addressing the Indiana Engineering Society.

I do not hold a brief for the contractor's interest or welfare, but it is clear to me that, if we are to get the high quality work, the reasonable construction cost, and the record time operation, all of which we so much desire, it is up to us to help the contractor in our negotiations with him and to endeavor to accept more of his viewpoints than has been our practice heretofore.

Not only are the State Highway Commissions of the country outlining in a definite way highway programs for this year and several years to come, but county and city officials are more keenly interested in pushing highway and street construction work than they have ever been before. Millions of dollars are being appropriated and spent in all lines of building construction, and the men who play the greatest role in the execution of these various construction programs are the engineers and the contractors.

Getting the Contractor's Viewpoint

There are many new contractors doing highway work and they have not figured properly upon the contingencies which must be met, but whether the chief reasons for the loss of money are to be found in the contractor's methods of handling his work or in conditions imposed upon him by the engineer is a debatable question. Be that as it may, the fact remains that the engineer can do much toward overcoming the losses and more especially the difficulties of the contractor, if he will but assume to a greater extent, than has been the practice, the contractor's viewpoint.

In other words, the engineer in charge of the work would, under this plan, use the same methods and consider the same items in estimating his costs as would the contractor in figuring his bid price. In this connection, and singularly enough at this time, the Wisconsin Highway Commission held a conference at Madison, December 2-4 inclusive, which was attended by nearly 200 representatives of the road building forces of the state, including county engineers, contractors, machinery and materials interests. Difficulties and grievances arising during the past season were freely and frankly discussed and in nearly every case solutions were agreed upon which will help to rapid progress the 1920 program. This now involves about 400 miles of concrete roads. A permanent committee was organized which will be known as the Uniform Cost Accounting Committee, which will collect data on the factors affecting costs and estimates so that the information may be available for next year's work. This Committee consists of twelve, five of whom represent state and county interests, five of whom represent the contractors and one each the machinery and materials manufacturing interests. This meeting was out of the ordinary in many ways and constituted an important step toward solving the difficulties presented by a large road-building program.

Getting Reasonable Prices

The engineer is naturally desirous of securing as reasonable bid prices on work as possible. He acts as the agent of the taxpaying public in township, county or state, and that public looks to him for an economical expenditure of its funds in the construction of highways. If reasonable prices are to be expected from contractors for construction work, then certain concessions must be made to them with this end in view. The causes which create high prices can be removed, naturally resulting in lower prices, but a lower price level, under existing conditions, would be less reasonable or fair than present prices.

Whenever the contractor is in doubt, when he is confronted with uncertainties, when he assumes certain extremely indefinite hazards, he endeavors to cover up or secure himself against possible loss by making his bid price accordingly. At this time in the majority of paving contracts the contractor assumes all the hazards and in proportion to the risks and hazards incurred does his bid prices increase.

Two Classes of Hazards

The hazards to be encountered may be divided roughly

into two classes. First, those, which although usually inevitable, it is nearly impossible to assign just to what extent the cost to the contractor has been affected, even after the work is completed. Under this class would come the hazards due to weather conditions, shortage of labor and inadequate transportation facilities.

The second class covers those hazards which, when they occur, the financial effect upon the contractor can be definitely calculated. For example, a revision in freight rates during the life of the contract. Under this condition the contractor could readily show in a definite way how much more or less the work cost by simply computing the difference in freight rates on the materials involved.

These examples are perhaps sufficient to indicate the classification of hazards, the majority of which, if not all, the contractor considers when figuring his bid price. His additional cost for assuming these hazards is in the nature of insurance. If the risk or hazards were removed, then there would be no need for an insurance charge and the bid price would be proportionately less. It is, of course, generally conceded, that the aforesaid risk or hazards of the second class, could be better and more economically assumed by the public, and until such a change in our method is brought about the contractor will continue to make an appreciable charge for this invisable yet certain insurance feature.

Flexible Contracts

Contracts should be so drawn as to relieve the contractor of every uncertainty and hazard which it is possible to foresee. Surely every contract should provide for an adjustment in case freight rates are changed subsequent to the execution of a contract; if revised upward then additional compensation for the contractor, if downward, like advantage to the public. If, in order to hasten completion of work and to avoid delays, which are always costly to both the contractor and the public, it would appear desirable that materials be stored on job in quantities, the contractor should be allowed a reasonable advance on such materials. If required to store materials but paid only for completed work, the contractor must, in protection to himself, charge for the service and subsequent risk, and this charge included in the contractor's bid price would be more than would the cost to the public for advancing to the contractor sufficient funds to pay for the stored materials.

Removing Uncertainties

However, it is not so important here to give specific examples as it is to call attention to the fundamental principle that the bid prices will be reduced in proportion to the risks and hazards from which the contractor is relieved. The engineer may well consider every risk and hazard which may arise during the designated term of any contract, and so draw his specifications and contracts as to relieve the contractor of every uncertainty possible. A method which imposes upon the contractor all the risks and exacts that he do all the guessing is both costly and unbusinesslike.

THE MAINTENANCE OF MACADAM ROADS

By L. G. Quigley, M. W. S. E., The Barrett Co., 10 S. La Salle St., Chicago, Ill.

In localities where macadam roads now exist, the question the engineer has to ask himself is whether or not he can put the old road in shape and maintain it acceptably to the public for less than the interest and depreciation charges on a new road. In the case of building new macadam, the question is whether or not the interest on the difference in cost between the macadam and the more expensive types would maintain the macadam road.

By "macadam" we are only considering the roads built of slag or broken stone, the voids of which are filled with screenings or fine gravel and bound together with water and rolling, and not the so-called stone road, dumped, not built, in the center of a dirt road with blind faith that it eventually will be a road.

Three Methods of Maintaining Existing Roads

There are three primary methods of maintaining existing roads:

1. By scarifying and reshaping with the possible addition of new stone, and rebinding with water and rolling.
2. By patching.
3. By surface treating with hot or cold bitumens.

Reshaping

The first method is efficient and economical only on very light traffic roads where scarifying is necessary at long intervals, say not less than three years. The surface stone should be loosened and ploughed up with some form of scarifier used in connection with a roller or tractor. This should be done to the average depth of the holes, usually between 2 and 4 ins. The loose material should then not only be shaped to proper crown but should be thoroughly mixed by the use of the blade grader. By simply grading the loose material, spots of fine material are left which would again soon become holes. The loose material should therefore be moved several times to insure a uniform surface of coarse and fine stone. The road should then be thoroughly saturated with water and rolled. If the work has been properly done, it is seldom necessary to add more screenings except when more coarse aggregate is placed on the road. A mat of screenings should never be left on the surface. It looks pretty on the road but is not so nice on the clothes of the users of the road and on the surrounding landscape.

Patching and Surface Treating

The macadam can be maintained efficiently by the patching method only where surface treating follows; therefore, we will consider these methods together. When an existing macadam road that has been neglected is to be revived, the question that comes up is whether it is best to bring the surface to true crown and grade by scarifying or by patching. Surface treating alone will not make a bad road good.

Where the cost of patching nearly equals or is greater than the cost of scarifying, scarifying is to be preferred, as this method when handled as above described gives a uniform surface for bituminous treatment.

If the surface has a few holes, but it otherwise in good condition, patching should be done. It is hardly necessary to say that this patching should be done only with the use of bitumen, and never with stone or screenings alone, since even when surface treated, such a patch is never thoroughly bound and easily breaks out. When hot refined tar or asphalt is to be used, the hole should be

first thoroughly cleaned and the edge trimmed so that the sides of the hole are nearly vertical and then filled with stone that will pass a 2¼-in. ring, and be retained on a 1¼-in. ring. Smaller sizes are called for in shallower holes. The stone should then be tamped or rolled and then covered with hot bitumen, using approximately one gallon per square yard of surface per inch in depth. The bitumen should be immediately covered with ¾-in. chips and thoroughly tamped and rolled.

Care should be exercised that the finished patch is not higher than the surrounding surface. Patching has been made much easier by the introduction of cold patching tar, which can be mixed cold with sand and stone either by hand or in a concrete mixer. The resulting mixture is rolled into the holes and ruts and sets up finally like the bitumen applied hot. This method requires little equipment and a large mileage can be handled rapidly.

Surface Treating New Macadam

In surface treating new macadam it is generally advisable to open the new road to traffic for a few weeks to permit vehicles to loosen up any caked fine material on the surface. When the road surface is dry it should be thoroughly swept with rotary horse-drawn brooms or by hand-brooming or both. It is very essential that every bit of loose material be removed from the road. The bitumen should then be applied, preferably with pressure apparatus, or, if gravity distribution is used, a decided improvement can be made by using a broom drag directly behind the distributor. This broom drag is constructed with 4-in. strips to make a frame approximately 4 ft. by 8 ft. using push broom heads on the 8-ft. side. Both the pressure distribution and the broom drag insure that the bitumen thoroughly penetrates into the top surface of the road.

The only bitumens that should be considered for this class of work are the refined tars applied either hot or cold, or the heavier grades of asphaltic base oils. The light dust-laying oils have no binding qualities whatsoever and depend upon weighting down the dust particles to keep the dust from flying. For the first application on a newly treated road about ½ gal. to the square yard should be applied. If cold bitumens are used, it is a decided advantage that this first application be made in two ¼ gal. treatments, since there is less chance for wasting material, and it permits better penetration into the road surface.

When hot refined tar or asphalts are used, it is quite necessary that the macadam surface presents a nubby or grainy appearance. Hot applications do not penetrate into the surface of the road, but depend for their efficiency upon the mat sticking to the surface. The hot surfacing is best suited for roadways on which a large majority of the vehicles are pneumatic tire pleasure vehicles, such as boulevards and light residential traffic streets.

The covering for the cold bitumens should be as large in size as the bitumens will retain on the road surface, and this covering should be applied sparingly, as an excess of covering tends to blot up the bitumen from the surface of the road and lessen its penetrating qualities. The size to be used with hot bitumens runs larger, and should be the hardest kind of road metal, as this kind of covering will prevent creeping and rutting of the road surface.

It is also an added advantage when using hot surfacing to roll the road metal into the bitumen, as traffic is very apt to throw a large amount of the chips off the surface that would otherwise be bound by the bitumen.

Making Repairs

After the macadam road has been properly treated the first time, it is very easy to keep it in an excellent state of repair. It should be regularly gone over and the small holes that develop should be immediately patched as described above under patching. When the first surface treatment begins to show signs of wearing through, it is advisable to give it another treatment. The second and succeeding applications as a rule should be about one-half the amount per square yard used in the first treatment. Care should be taken not to build up a thick covering on the road surface. A thick covering is not an advantage and may be a disadvantage, as it is very apt to shove into waves or rut badly.

The Cold Penetration Method

Building the maintenance into the road is a new idea in macadam road building. Some localities call it the cold penetration method. In a few words it consists in building the macadam road as ordinarily built with the exception that when filling in with screenings cold refined tar is applied in three or four applications much the same as water is used in ordinary macadam construction.

It can be readily seen that this is not a very expensive proceeding, and in many cases the water has to be hauled from a long distance, so the difference between the cold tar penetration and waterbound macadam is small. The macadam road built in this manner presents an ideal surface for future maintenance. LaCrosse County, Wisconsin, has had decided success with this method of construction, as well as many other counties in Illinois and other states.

The macadam road maintained, as above outlined, we believe, solves to a large extent the problem which confronts so many county and suburban localities.

The foregoing is the major portion of the address recently delivered by Mr. Quigley at the University of Illinois Road School.

THE ROAD-MAKING MATERIALS OF NEBRASKA

By A. S. Mirick, Chief Construction Engineer, Nebraska Department of Public Works, Lincoln, Neb.

Platte River Gravel

The most valuable road-making material we have in Nebraska at present for both surfacing, concrete bases and concrete paving is the Platte River gravel. This material is pumped from the Platte River. The effluent of

the pump carries the sand and gravel to a system of sorting screens and chutes, where the finer materials are returned to the lake pit. The gravel is delivered to the bins; about one car load of gravel is produced to two car loads pumped. A typical analysis of this material shows the following composition:

Passing ¾-in. screen, retained on ½-in. screen	2.0%
Passing ½-in. screen, retained on ¼-in. screen	12.7%
Passing ¼-in. screen	85.3%
Retained on ¼-in. screen	14.7%
Passing ¼-in. screen, retained on 10-mesh	44.7%
Passing 10-mesh screen, retained on 20-mesh	27.9%
Passing 20-mesh screen, retained on 30-mesh	5.5%
Passing 30-mesh screen, retained on 40-mesh	3.1%
Passing 50-mesh screen, retained on 80-mesh	1.9%
Passing 80-mesh screen, retained on 100-mesh	0.2%
Passing 100-mesh screen, retained on 200-mesh	0.5%
Passing 200-mesh screen	0.5%
Loss by washing, silt or clay	0.4%

The character of the material consists essentially of rounded fragments of granite, quartz and quartzite with a large amount of sub-angular quartz sand.

You will see that if the dividing line between sand and gravel is the ¼-in. mesh sieve, very little of this material can be called gravel. The fineness of its composition has always perjudiced highway officials as to its suitability for concrete pavement. However, last summer a test was made of the material at the Bureau of Public Roads, Washington, D. C. Two 6x12-in. cylinders were prepared, and aged 7 days, of Platte River gravel, mixed one part of cement and three parts of gravel. Two cylinders of concrete made of screened Potomac River gravel mixed one part cement by volume to 1½ parts of Potomac River sand and three parts of Potomac River gravel. The average total load sustained by the Platte River gravel cylinders was 62,145 lbs.; the Potomac River gravel sustaining a load of 57,980 lbs. The unit load in pounds per square inch was 2,198 lbs. for the former and 2,050 lbs. per square inch for the latter.

A later test of this same material mixed in proportion by volume of one part of cement to 2½ parts of sand gravel sustained a total load of 84,850 lbs. or a unit load of 2,800 lbs. per square inch. As a result of these tests it was decided to use this material for concrete pavement and as a base for other classes of paving throughout the state. This material can be obtained any place along the Platte River and will aid and also hasten the building of hard roads within the state. The material can be produced cheaply in comparison with other material and the supply is unlimited.

Bank Gravel Deposits

The material next in importance is our bank gravel deposits. These are widely distributed throughout the state and can be used both for concrete and for road surfacing. They are, in general, rather fine in composition, but compare very favorably with the Platte River sand gravels. As we progress westerly through the state the composition of our gravel becomes coarser, and in the extreme western part of the state to use the gravel supplies economically, the coarser materials will have to be crushed.

Rock Deposits

Rock deposits outcrop in the eastern, western, southern and northern part of the state. In general the most useful rock for road-making material is the limestones found in the southeastern part of Nebraska. A large tonnage is produced annually and is used for all kinds of construction. The leading quarry companies operating in the state are the Burlington Quarry, South Bend, Natural Stone Co., and the Murphy Construction Co., Louisville; Woodworth Quarry, Meadow; Atwood Quarry, Cedar Creek; Western Stone Co., Nehawka; Olson's Quarry, Weeping Water; Davis Quarry, Wymore; Blue Springs Quarry, Blue Springs. This stone has been used for macadam roads, concrete bases, and all engineering structures. The test of samples of the various stone show a French coefficient of wear from 5 to 11. If care is taken in the quarrying operations to eliminate the shale that occurs with the limestone, a quality of stone can be produced that will be suitable for any class of pavement.

The limestones in other parts of the state are soft and are suitable for temporary surfacing. The northern and southern limestones of the Niobara groups are valuable for the manufacture of cement and there is room for considerable development in this industry within the state. In the northwestern part of the state, so-called magnesia rock is found. This rock has the property of binding the sandy soil in the region where it is found. If the road is kept moist, it makes a splendid road. The riding qualities of these roads are equal to a good macadam pavement, and it is much cheaper to maintain.

Imported Aggregates

Where coarse aggregates are used in pavements, subject to abrasion, it has been the practice of many cities in the past to import Sioux Falls granite, so-called. This stone is a hard sandstone and is very durable; many fine stretches of pavement have been constructed out of it.

For asphaltic concretes and minor concrete work, it has been the custom of the southern tier of counties to import Chatz or tailings from the zinc mines of Joplin, Mo. The use of this material has been fairly economical in the past when freight rates were low; however, at the present high rates it is classed as costly.

Sand Deposits

The sands in the various parts of the state are mostly river deposits and are of an excellent quality. In the central part of the state the deposits are ideal for sheet asphalt, both as to grading and quality. Good concrete sand is found abundantly. Most of the deposits are river deposits, and the chief characteristics are the hardness of its grains and its cleanliness.

Temporary surfacing is necessary in many parts of the state. In the north and central west part of the state we have the sand hill region. This area comprises about 20,000 square miles and is the pasture land of Nebraska. The surface of this region has been shaped by the wind and presents a varied and grotesque appearance. It is mostly grassed over, and traveling over the sod is not difficult. However, if the hills are cut down, or any grading attempted it is practically impossible for traffic to go through it. The sand hill roads of Nebraska are one of our problems. We know that a brick or concrete pavement would answer the question admirably; but in a country where it requires 11,000 acres of land to graze 1,000 head of cattle, you may be sure the population is

sparse to say the least. This region will never be able to build hard roads until the state, by means of a bond issue, takes care of the roads through the region. Therefore, the State Highway Department is interested at present only in temporary surfacing. On the level stretches, it is better to leave the road as nature left it with the prairie grass still on it. But where the hills have to be cut down some sort of surface is necessary. Of course where there are deposits of clay or alkali mud in the region, a sand clay surface can be constructed that will answer the purpose very well. Where supplies of this nature do not abound, the sand hill road builder has recourse to the only available material he has—hay. He hays the road twice a year and up to the present time is still doing it, and I am afraid he will still continue to do so for several years to come, for it is the only practical road-building material he has at his command.

The supply of road material is not the most serious matter with us, for our quarries and gravel pits can produce enough material to supply our wants. The great trouble is to secure cars to ship the materials to the consumer. The production, therefore, is not proportional to the demands or to the capacity of plants, but is directly proportional to the open top cars available. Besides the lack of transportation facilities, the shortage of labor is always with us, and will be the greatest factor in curtailing road progress this year. Nebraska, in the face of these handicaps, feels that if she cannot build hard surfaced roads now, she can at least prepare the grades for them.

Acknowledgment

The foregoing is from an address by Mr. Mirick before the conference of Mississippi Valley Association of Highway Officials held in Chicago early in February, this year.

METHOD AND COST OF CONSTRUCTING GRAVEL ROADS IN WILSON COUNTY, KANSAS

By M. W. Watson, State Highway Engineer, Kansas Highway Commission, Topeka, Kas.

Wilson county, Kansas, located geographically in the southeastern part of the State, is in one of the large oil-producing regions of the United States. This reason, if no other, makes it necessary to employ some type of hard surfacing on the main traveled roads of the county. The county engineer, county commissioners and others interested in road affairs made a careful investigation of available materials and found that an abundant supply of road gravel could be obtained in practically all of the west two-thirds of the county. This gravel is usually found in slight knolls under from 1 to 3 ft. of soil and is obtainable at the small cost of 6½ cts. per cubic yard.

The gravel ranges in size from fine material to that passing a 1½-in. ring and contains about 12 per cent. of clay binder. It has exceptionally good bonding qualities and considering the low first cost and ease of maintenance, the decision of the road officials to adopt the gravel type for their county road system is certainly logical.

Finances

The laws of Kansas permit the formation of a benefit district for the improvement of a section of highway. The petition must contain a complete description of the proposed improvement, the land lying in the district, the type and width of the improvement and the number of annual assessments, from 10 to 20, over which the cost is to be distributed.

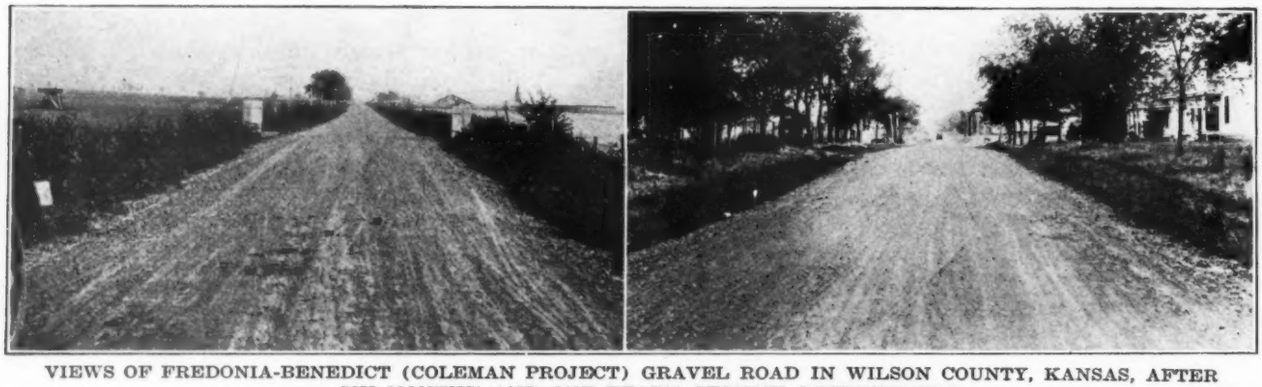
The district for gravel road work is usually about 1 mile on either side of the proposed road. The law requires that the petition must contain the signatures of 51 per cent. of the resident land owners, owning 35 per cent. of the land, or 35 per cent. of the resident land owners, owning 51 per cent. of the land, or the owners of 60 per cent. of the land lying within the district. By resident land owners the law refers to any persons owning land in the district and living in the county. After the petition has been properly signed it is presented to the board of county commissioners and they, by appropriate action, declare the road to be a public utility and order the surveys and plans prepared by the county engineer. After the surveys have been made and the plans prepared the plans and estimates are submitted to the State Highway Engineer for his approval, after which the board of county commissioners may either award a contract or construct the work themselves. The latter method has been selected by the board of county commissioners in Wilson county.

Labor

The bulk of the labor employed on this work is obtained from farmers. Floating labor usually is unobtainable owing to the location of the county in the oil region, where much higher wages are paid by oil companies than could be paid on this class of work.

Earth Work

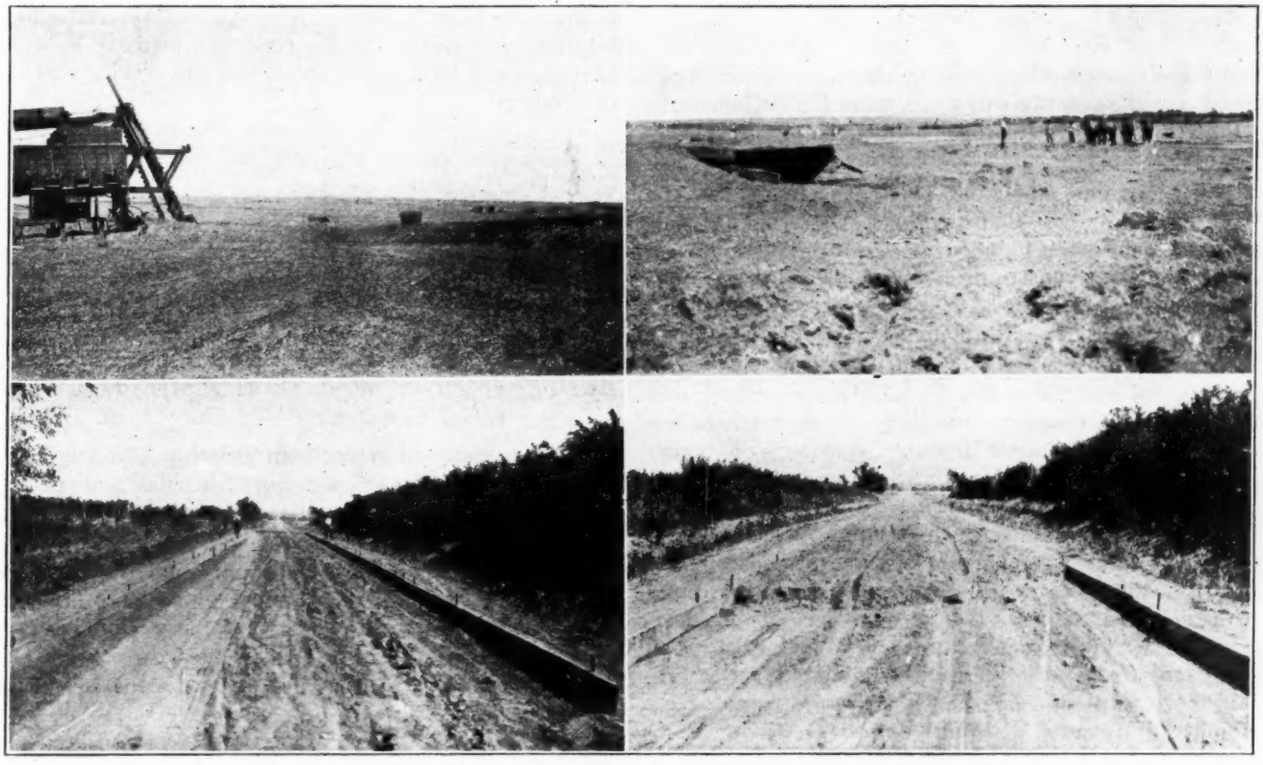
Much attention is given to the preparation of a proper



VIEWS OF FREDONIA-BENEDICT (COLEMAN PROJECT) GRAVEL ROAD IN WILSON COUNTY, KANSAS, AFTER SIX MONTHS' AND ONE YEAR'S SERVICE RESPECTIVELY.

roadbed before placing the gravel. Since the roads are slightly rolling and the soil is of clay and the gravel used possesses excellent bonding qualities, the feather-edge method of construction is found to be most desirable. The sub-grade is constructed with a crown of about ¼ in. per foot, without any shoulders to obstruct proper drainage of the sub-grade previous to final compaction. The side slopes from the berm into the ditch are 2½ ft. horizontal to 1 ft. vertical. The ditch is of the flat bottom type 24 ins. wide and 24 ins. deep, and has an outside slope of 1½ ft. horizontal to 1 ft. vertical.

With the exception of materials requiring a longitudinal haul, the bulk of the earth is moved by means of the ordinary blade grader. All cuts or fills requiring longitudinal movement of earth are first made by the use of wheel and slip scrapers, after which the ditches are cut by means of the blade grader, using for the bottom of the ditch a small machine, while the larger grader was used to prepare the embankment and to cut the outside slopes. In many instances outside slopes as high as 5 ft. have been cut with an ordinary blade grader.



VIEWS OF CONSTRUCTION OF GRAVEL ROADS IN WILSON COUNTY, KANSAS.
Left to Right:—Galion Gravel Screening and Loading Plant—Loading Trap—Forms Set for Spreading Gravel—Gravel Spread and Forms Removed.

Loading and Hauling

Before starting construction the county purchased a Galion loading and screening device, which has been used in the main for the loading of gravel. In some instances, where only a few teams were in use, and in the event more teams were on the work than could be supplied by the loader, wagons were loaded by means of a loading bridge.

The county purchased a truck, which is used for hauling gravel, but during a large part of the time the truck was out of commission on account of engine trouble, so that most of the hauling has been done by means of teams.

In order to care for the shortage of labor and teams the county engineer employed some unique methods for handling the hauling on this work. The farmers in the vicinity were informed that at any time when they had one or more days that their teams were not required for use on the farm they could report to the hauling foreman and haul for that length of time. In this manner the work was carried on even during the busiest farming season. During harvest, when the usual complaint is filed in Kansas that road work interferes with farm operations, the engineer published a notice that any farmer encountering a shortage of help could obtain assistance by applying to the engineer, who would release such men or teams as were needed to assist in the farm work. By this method hearty co-operation was secured and the most friendly relations exist between the county authorities and the farmers.

Placing of Gravel

In the usual gravel road construction little attention is given to the careful grading or measurement of the material deposited and as a rule an irregular surface is the result. But on this work one of the principal features is the care used in placing the gravel. Before any material is deposited grade stakes are set and side form boards placed, being firmly held by strong stakes and iron pins. Two by eight-in. planks are used for this purpose, giving a depth of gravel at the side of 8 ins. and a center depth of 6¼ ins. The material is spread by means of a blade grader and finally screeded to obtain a uniform depth. After the material has been dumped for a sufficient dis-

TABLE I—ACTUAL COST DATA OF COLEMAN GRAVEL ROAD PROJECT IN WILSON COUNTY, KANSAS, IN 1918-19

Grading			$ 507.41
2,572 cu. yds. gravel at 6½c			167.18
Loading 2,572 cu. yds. at 17c			440.25
2,061 cu. yds. hauled on unit price at 70c	$1,442.70		
135 cu. yds. hauled on time	91.40		
376 cu. yds. hauled by truck	227.60		
2,572 cu. yds. gravel hauled	$1,761.70	—	1,761.70
Leveling			240.31
Cement	$ 156.10		
Crushed rock	16.50		
Steel	38.89		
Sand	9.34		
Freight on sand	22.42		
Chatts	10.27		
Freight on chatts	38.60		
Miscellaneous	21.30		
Hauling bridge materials	61.46		
	$ 374.88	—	374.88
Superintendence			163.83
Engineering expense—			
Labor	$ 30.59		
Miscellaneous	15.00		
	$ 45.59	—	45.59
Total			$3,701.15

Length of project, 1¾ miles.
Cost per mile, $2,691.75.

tance it is thoroughly harrowed by the use of a stiff tooth harrow and the form boards are removed, allowing traffic on the gravel to give it proper compaction.

Rolling

Rolling was first attempted, but it was found that the use of a roller on this kind of gravel gave very little better results at a much higher cost than to allow traffic to compact the gravel and to reshape it when it became scattered over the roadbed.

Finish

After the roadbed has been opened for traffic it is carefully dragged with the ordinary road drag after each rain and where appearances of pockets or depressions are found, a slight additional amount of material is sometimes added in order to furnish a uniformly smooth surface.

Approximately 19 miles of this work have been practically completed. A comparison of the estimated and actual cost of the Coleman project are shown in Table I and the detailed cost data of the same project in Table II. This work was constructed during 1918 and 1919. The county officials of Wilson county find it difficult to restrain more petitions being filed than can be handled for a number of years. All bridge and culvert work along these roads is being put in of first-class construction, and if in the future it is found that a gravel road is not satisfactory for the traffic, it will be a simple matter to prepare the sub-grade for one of the more permanent types of surface.

Assessments

After the work is completed and paid for the board of county commissioners apportion the cost of the improvement between the county, the township and the land in the benefit district as follows: The county pays 50 per cent. of the cost; the townships lying in the district pay 25 per cent. of the cost, each township paying in proportion to the area of the district lying therein, and the land in the benefit district pays 25 per cent. of the cost.

The board of county commissioners can pay the county's share out of any funds that they have on hand, or they can allow bonds to be issued for the period covered by the petition and levy a tax each year to pay the interest and principal on the bonds. The township's portion must be allowed to run as bonds, while the assessments against the land in the benefit district can either be paid in cash or by annual assessments for the payment of the principal and interest on bonds.

In assessing the benefits against the property the board of county commissioners take into consideration the benefit accruing to each piece of property with reference to its location with respect to the road, the increase in valuation that will be brought about and the service that will be rendered.

The work started in 1918 under the supervision of H. S. McFadden, county engineer, and is now in charge of C. P. Donald, county engineer.

DESIGN OF NEW SEWAGE TREATMENT WORKS AT FORT SHERIDAN (ILL.) GENERAL HOSPITAL NO. 28

By H. R. Abbott, President, The H. R. Abbott Co., Chamber of Commerce Bldg., Chicago, Ill.

As any connection with an existing sewerage system, for the disposal of the Fort Sheridan sewage was impracticable, it was the writer's recommendation that a complete sewage treatment plant be built inasmuch as the effluent from the plant would have to discharge into Lake Michigan. Accordingly, plans were prepared in the Sanitation Section of the Construction Division of the Army in Washington and the entire work executed in connection with the general construction of the entire Hospital project.

The treatment works consist of a diversion box, septic tank, dosing chamber, trickling filter, chlorinating and humus chamber, secondary settling tanks and sludge drying beds.

Diversion Box

As the new plant is immediately adjacent to the old one (built in 1912) provision was made for diverting a

TABLE II—COMPARISON OF ESTIMATED AND ACTUAL COST OF COLEMAN GRAVEL ROAD PROJECT IN WILSON COUNTY, KANSAS.

Item	Estimated Quantities	Unit Estimated Price	Estimated Cost	Actual Cost	Actual Quantity	Actual Cost per Unit
Excavation	4,079 cu. yds.		$ 417.48		4,079	
Shaping Subgrade	19,552 sq. yds.	.02	391.04	504.41		
Cost of Gravel for Roadway	2,536 cu. yds.	.06½	164.84	167.18	2,572	.06½
Loading Gravel	2,536 cu. yds.	.10	253.60	440.25	2,572	.17
Hauling Gravel	2,536 cu. yds.	.65	1,648.40	1,761.70	2,572	
Spreading and Rolling	13,041¾ sq. yds.	.05	652.09	‡240.31	13,041¾	
Plain Concrete in Culverts	47.29 cu. yds.	8.00	378.32	*374.88		
Reinforced Concrete in Culverts	23.35	12.00	280.20			
Eng'g and Superintendence			209.30	194.42		
Miscellaneous				15.00		
Overhead and Contingencies			219.76			
Rolling Omitted.		Total	$4,615.03	$3,701.15		

* Labor performed by prisoners.
‡ Rolling omitted.

portion of the flow to the old plant if occasion demanded. The 12 in. force main terminates in a concrete chamber 7 ft. 6 ins. x 10 ft. extending above ground and set at such elevation that a gravity flow is afforded to either the new or old plant. By opening the valves at the inlet ends of both plants, the flow would be automatically divided, at the ratio of 3 to 1 between the new and old plants respectively. It has not been necessary to use the old plant except for short periods when the new filter was rested.

Septic Tank

The tank is the standard construction division type, one story, multiple-compartment, horizontal flow, provided with baffles and cross-walls, or wiers, in such manner as to facilitate sedimentation and the withdrawal of the sludge. The entire structure is 43 ft. x 90 ft. and is covered with a wooden house equipped with shuttered windows and large louvers. All openings are screened. A dividing wall separates the tank into two units, each unit having four compartments. Pyramidal bottoms, sloping to a 3 x 3 ft. sump are provided for each compartment. These slopes are laid at an angle of 40 degrees from the horizontal. The sludge draw-off pipes terminate in this sump. A 4 in. water pipe line was laid connecting the sludge pipe lines at the tank with the Hospital supply system. This water pressure is desirable in flushing the sludge pipes after sludge is drawn, hosing down scum and agitating the sludge in the bottom of the hoppers for short periods by applying pressure through the sludge pipes. The total depth from the flow line to the bottom of the sump is 18 ft. and from the flow line to the top of the hopper slope is 9 ft.

The total capacity of the tank, including the sludge hoppers is 290,000 gals. and the capacity of the hoppers only, 66,000 gals.; this is equivalent to a per capita capacity of 41 gals. gross and for the hoppers only, 9 gals., based on a 7,000 population. The estimated flow of sewage in designing the plant was as follows:

4,800 patients at 150 gals. .....720,000 gals.
2,200 others at 100 gals. .....22,000 gals.

940,000 gals.

Average for all 134 gals.

On this basis the tank would have an average detention period of about six hours. However, as this maximum estimated population was never reached by 25% the detention period was increased a corresponding amount, as the actual water consumption was very close to that estimated.

Ground was broken on Nov. 10, 1918, and first sewage turned into the tank March 27, 1919. No septic action or gasification could be observed until July 16th, a period of nearly 4 months, although the tank had been seeded with ripened sludge from the old plant. This delay in the tank starting up was probably due, in part, at least, to the large quantity of disinfectants used in the hospital and discharged into the sewer. Upon investigation it was found that Dakins' solution, lysol, cresol, carbolic acid and other disinfecting chemicals were used extensively.

The tank is designed on the simplest possible lines, in order to facilitate construction and reduce the cost to a minimum. On account of the shallow depth, the time required for construction, as well as the cost, is a great deal less than that required for Imhoff tanks. Another feature is the maximum effect in sedimentation, thus offering protection to the filter where an excessive quantity of grease is carried in the sewage. The process of digestion of the retained organic matter in a well "ripened" tank has been described "as a series of stages. The products of decomposition differ considerably in the different compartments, the effluent from the last compartment being much superior to that in the first compartment."

At the outlet end an inclined baffle is placed, so arranged as to prevent the "carrying over" of the suspended matter, a similar baffle is placed in the first compartment at the inlet in order to retain the grease and afford an opportunity for skimming. Sludge is removed from the several compartments by draw-off pipes leading to the drying beds, or sludge can be transferred from one compartment to another by drawing down the liquid by separate draw-off valves and obtaining the necessary head. Sounding boards 15 ins. square with small pigs of lead attached were suspended by pulleys over each compartment for determining the depth of sludge.

Siphon Chamber

The effluent from both units of the tank flow to a trough 24 ins. wide and 10 ft. long, from which the discharge is over a sheet iron wier and into a siphon chamber. The trough is housed in and midway between the tank and the siphon a 3/16-in. triangular mesh screen is placed as a protection to the filter. An extra screen is provided and is placed before the one requiring cleaning is withdrawn. It was found that one cleaning per day was sufficient for this screen. A Sanborn 24 hour clock, water level recording gauge is placed in this gallery. A flow diagram was worked out and chart posted for the use of the attendant. This apparatus is also an excellent check on the pumping operations at the Sewage Pumping Station as any stopping of the pumps for a considerable period, or bypassing of this raw sewage into the lake at that point would be indicated on the recording chart.

The siphon chamber is pyramidal, 12 x 12 ft. at the top and 4 x 4 ft. at the bottom, equipped with a Miller 6 in. automatic siphon having a 4 ft. 6 in. draft and a maximum head on the sprinkler nozzles of 7 ft. The capacity of the chamber is 2,300 gals., and at the average flow of 700 G. P. M. the filter is dosed every 3 1-3 minutes. When the filter was first started up it was found that air was being carried into the drum of the siphon by the action of the liquid spilling over the wier and falling near the bottom of the drum. As this prevented the proper operation of the filter, wooden baffles were placed across the chamber at the bottom of the drum, concrete flared away at the sides of the wier opening and certain adjustments made on the siphon vent tubes. No trouble was experienced in the operation after these changes had been made. The siphon chamber is housed and is directly connected with the gallery containing the recording apparatus.

Trickling Filter

This filter is 106 x 205 ft. or ½ acre in area. Filter-

ing medium is Illinois limestone and the specifications called for sizes ranging from 1 to 3 ins. Trouble was experienced in obtaining clean stone and a considerable quantity had a large percent of screenings and stone dust. This dust gradually worked down to the gutters, after the filter was put in operation, and finally found its way to the humus chamber. This necessitated frequent opening of the blow-off valve in this chamber, during a period of about two months, after which the dust finally disappeared. The depth of stone is 5 ft. and is deposited on an undulating concrete floor, the lateral distributing pipes being placed at the summits and the gutters in the depressions. The main distributor bisects the bed on the long axis, being 18 ins. in diameter at the siphon and stepping down gradually to 10 ins. at the end. From this distributor 6 in. laterals carry the effluent to 136 3 in. risers, four on either side of the distributor. The risers are fitted with 13-16 in. Worcester type of nozzle.

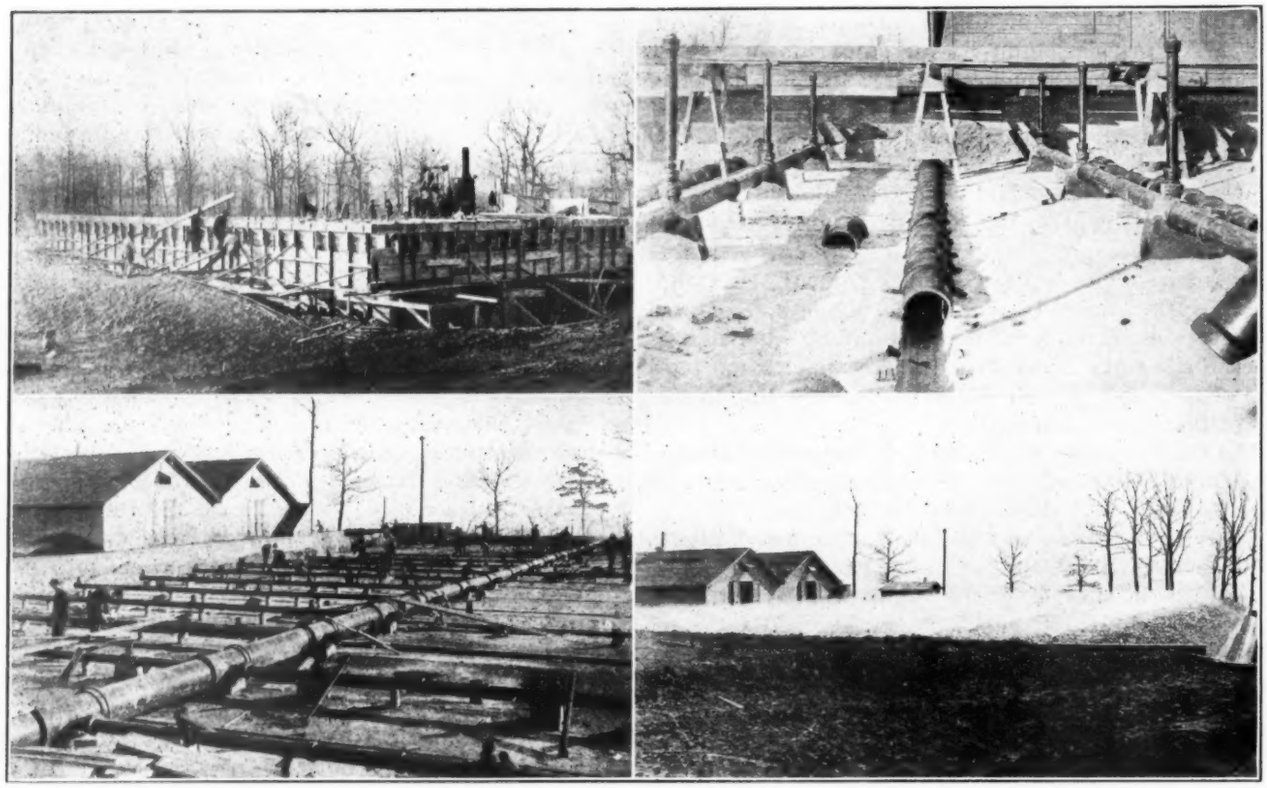
The arrangement of the spray nozzle is rectangular and spacing is 11 ft. 6 ins. The nozzles are on an inclined plane approximately equal to the hydraulic grade line at the average rate of discharge and the distributing pipes and under drains are parallel to this plane. A 2 in. bleeder line is connected to the distribution system for draining it if occasion requires. Wherever possible concrete retaining walls were omitted, terminating the filtering material with steep slopes. The under drains are 10 ins. in diameter, the invert being an integral part of the concrete floor and over this is placed 10 in. split tile supported by broken pieces of tile, leaving a clear opening of ¾ in. between the tile and the filter floor.

The filter is designed on simple lines, omitting several of the features heretofore considered more or less essential in municipal practice.

Chlorinating and Humus Chamber

The effluent from the trickling filter flows to a chlorinating chamber, having a capacity of 8,600 gals. above the hopper. This chamber is 13 x 17 ft. and covered with a house. A sealed partition divides this house in half, one portion containing the chlorinating apparatus, reserve chlorine tanks and platform scales. The tank in service is kept standing on these scales and the amount of chlorine used is determined daily as a check on the apparatus.

A Wallace & Tiernan, manual control, dry feed apparatus was installed and effluent is dosed at the rate of 2½ parts per million. The other portion of the house is used for the attendant's quarters and facilities were provided for making simple tests of the sewage effluent. Conical Imhoff glasses were installed for determining the percentage of settleable solids; also bottles for making the Methylene blue tests for relative stability. Flow charts, log book, printed forms for records, telephone and a set of operating rules were provided.



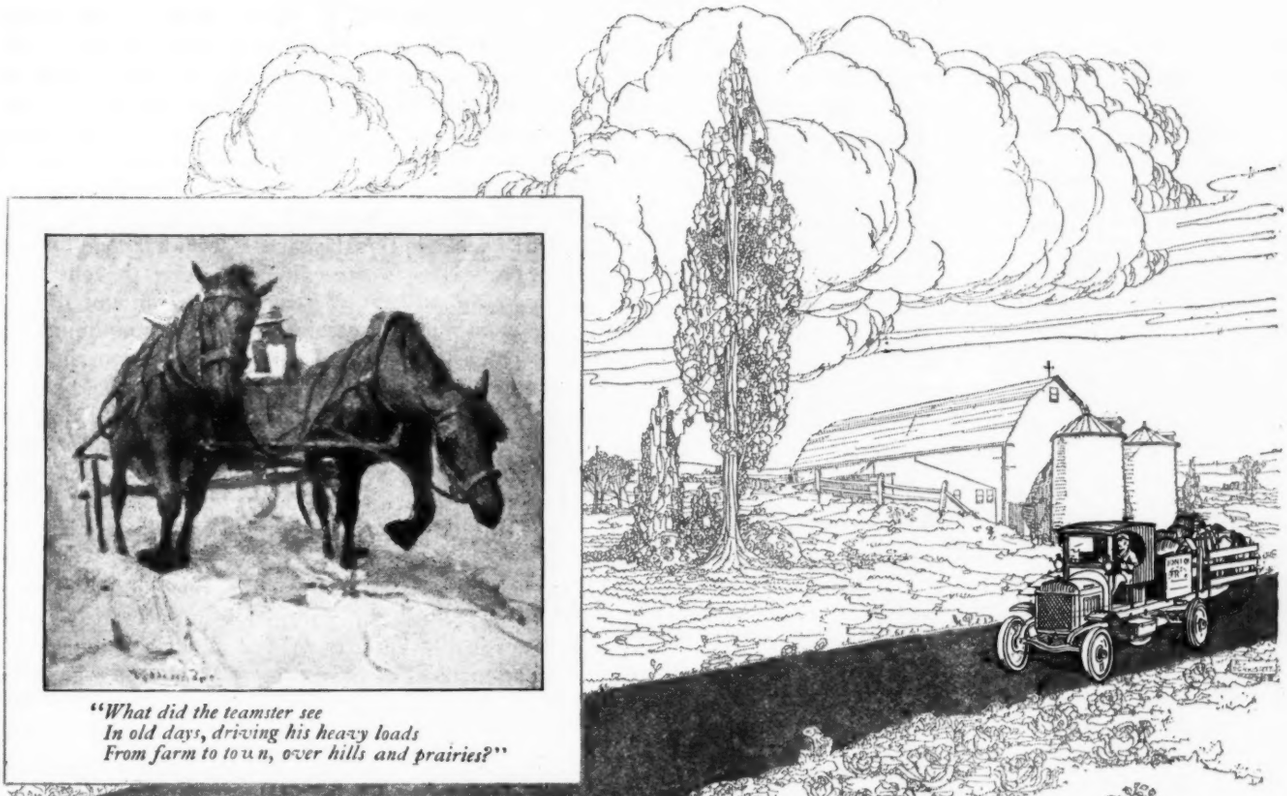
VIEWS OF SEWAGE TREATMENT PLANT AT FORT SHERIDAN (ILL.). GENERAL HOSPITAL NO. 28.

Top Row: Septic Tank with forms and steel in place for placing concrete—Shows underdrains in filter and risers in place; also shows movable trestle for dumping the crushed stone on the bed. Bottom Row: Main distributor and lateral pipes—Sprinkling Filter in operation.

Secondary Settling Tank

The effluent flows from the chlorinating chamber

(Continued on page 216)



"What did the teamster see
In old days, driving his heavy loads
From farm to town, over hills and prairies?"

A Vision of BETTER ROADS

WHAT did the teamster see
In old days, driving his heavy loads
From farm to town, over hills and prairies,
Through mud and flood and storm and washout,
By wood-roads and highroads and the great
National Highways from State to State,
His strong horses straining and sweating through
dust or mire—
What did that hardy teamster see
On those long, hard roads behind his laboring team?

Across the years he saw a vision,
Prophetic, happy, haunting and inspired—
A Vision of Better Roads in the days that were to be.
He saw broad, smooth highroads running everywhere
in a vast network over the country,
Roads without dust or mud or weariness or the
constant labor of repair,
Roads pleasant and swift to travel,
Roads clean and safe and paved,
Leading to great cities and friends and business and
on adventurous, delightful journeys,
All over this broad, beautiful land.
He saw himself and his wife going and
returning over these fair highways,
Making trips to town for shopping or pleasure;
He saw his boys and girls going to better schools,
and better satisfied with their home;
He saw an end to dreariness and monotony
and isolation;
He saw his produce carried quickly to market, and
anything he needed brought as quickly
back to his own door;
He saw happiness, comfort and prosperity in that
Vision of Better Roads—
The vision of things which his energy and
resourcefulness and courage are today
bringing to pass.

IT was "A Vision of Better Roads" that brought forth Tarvia—which has given smooth, dustless, mudless, waterproof highways to thousands of communities all over this vast land. If you are interested in good highways, write at once to our nearest office for booklets and further information.

Tarvia
Preserves Roads
Prevents Dust

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(Continued from page 214)

through a 15 in. running trap to two circular settling tanks, each 18 ft. in diameter with conical bottoms. These tanks were part of the old plant and the new layout was so arranged that they could be used as secondary tanks. The combined capacity of these tanks and the chlorinating chamber is 40,000 gals., affording a detention period of about one hour at the average flow. These tanks are provided with wooden trough wiers at the flow line and effluent passes through these to a collecting manhole, thence to a 10 in. discharge pipe extending down the bluff and carried out into the lake about 200 ft. and resting on piles. Sludge draw-off pipes lead from the conical bottoms of these tanks and connect with the same outlet.

Sludge Drying Beds

Sludge drying beds, 40 x 100 ft. were built, the bed being divided into four equal pockets. Concrete walls enclose the beds and form the dividing walls of the pockets. The area per capita is 0.6 sq. ft. The filtering material consists of 10 ins. of coarse rock, 5 ins. of gravel and 3 ins. of coarse sand, making a total of 18 ins. The beds are under drained with 6 in. vitrified tile laid with open joints and the liquid drains to the chlorinating chamber. Diversion boxes are provided for diverting the flow of sludge from the tank to any pocket. The sludge pipes are carried well inside the bed and are elevated about 14 ins. above the top of the filtering material; the discharge from the pipe drops onto concrete aprons in order to avoid erosion of the sand in the bed.

General

Daily tests with the Imhoff glasses showed a removal of settleable solid of 95 to 99% an average of about 98%. Relative stability of the filter effluent ranges from 80 to 99% on tests made in accordance with standard methods of water analysis.

The plant was constructed by the Sumner Sollitt Co., General Contractors for the entire Hospital project. The design is by Major L. S. Doten, Sanitary Engineer of the Construction Division. Work was carried out under the direction of the writer as Supervising Engineer.

The foregoing is extracted from a paper by Mr. Abbott before the annual convention of the Illinois Society of Engineers.

ALBUQUERQUE, NEW MEXICO, COVERS ALL MUNICIPAL EMPLOYEES WITH GROUP LIFE INSURANCE

The city of Albuquerque, N. M., announces an innovation in the way of municipal management in the form of equitable life insurance for all employes of the city from the city judge to the garbage collectors. The program includes all employes of the Board of Education and the teachers in the city schools.

James N. Gladding, city manager, entered into the contract for the city and Mr. E. Hickey acted for the Board of Education. The insurance is given without cost of any kind to the employes, and its benefits are in addition to employes' compensation. About 125 persons will be benefited by this unique program. The plan extends to all employes who have been in service one year, at which time an insurance certificate in the Equitable Life Assurance Society will be presented in the amount of $500. At the end of each additional year of service an additional certificate for $100 is presented. Among the city employes this year to year increase in the amount of the insurance continues successively until a maximum of $1,800 is reached. In the Board of Education there is a maximum of $2,000. In both instances the plan is made retroactive as to length of service, thus giving all employes credit for service rendered. Among the employes on the city pay-roll are 11 mechanics, 3 laborers and 11 clerks. There are 8 policemen, 17 firemen, the city judge, the city doctor, the city chemist and the city attorney.

Group insurance was introduced by the Equitable some 10 years ago. Under this form of insurance all the employes of an institution are covered under a blanket policy, without medical examination and without regard to the ages of the employes. The plan has had a very remarkable growth and it is estimated that there are today one million industrial workers protected by this form of insurance.

The action of the Albuquerque authorities is the first instance of such a program being extended to all the employes of a municipality, but it has for some years been in force in such institutions as the Union Pacific System, the Standard Oil Company, Montgomery, Ward & Co., and the American Sugar Refineries.

Group insurance is not confined, however, to large institutions, but concerns having fifty employes and up may take out such policies. The action of the Albuquerque authorities has attracted the attention of other cities and towns, and it may be expected that other communities will shortly be following suit.

KEEP THE CEMENT SACKS AT WORK

One empty sack at the cement mill is worth any number of them lying idle in dealers' or users' hands all over the country, in so far as shipment of cement is concerned. Like many other kinds of cotton goods, cement sacks are scarce. If every idle cement sack in the country were returned to the plant which sent it out, there would be considerable relief of the present shortage both of cement and sacks.

Besides, cement sacks cost cement users money—money which is not working for them as long as they keep the sacks in their possession and thus make it impossible for the manufacturer to buy them back.

This condition is simply another one of those seemingly trifling items of neglect that in its own way is contributing to keeping the wheels of industry from moving as regularly and as smoothly as all would like.

WATER WORKS SECTION

SOME PROBLEMS ENCOUNTERED IN THE REBUILDING OF WATER WORKS

By Charles Brossman, Consulting Engineer, Merchants Bank Bldg., Indianapolis, Ind.

The rebuilding of water works may involve a multitude of problems, but it is of especial interest as related to some of the smaller plants, as these town have a harder time to make ends meet as compared with the larger city, said Mr. Brossman, in address the Indiana Sanitary and Water Supply Association recently.

The more populous town, if it has the money, usually requires equipment of such size that it will operate economically, provided good engineering principles are followed, and in many such cases the question of plant economy is likely to become principally a boiler room question, because this is usually where the large loss occurs. By this I mean that assuming you have a good high duty pump, the duty will not change within a short period if the pump receives proper care, but the best boiler plant in the world, even if new, can be made to change its efficiency 10, 15 or 20 per cent. simply by improper firing, draft conditions or other matters, and this change may take place from hour to hour.

Reducing Fuel and Labor Cost

The small water utility is a harder problem than the larger installation. If such a plant be steam operated in a town of from 2,000 to 3,000 the boiler load usually is very light, the firing periods infrequent, and many times at from 20 to 30 minute intervals, and usually you will find the old compound duplex pumps or even the simple pumps running non-condensing.

Here will be found two large items: namely, coal and labor cost, and with the increased price of both within the past few years it becomes necessary to cut out all the labor possible and decrease the power cost to the minimum. I will illustrate how this has been done in several cases and what the results have been. In order that this may not be a theoretical comparison, I will take as the first illustration the town of Delphi, Indiana. Before being called on this work many different schemes had been advanced to cut the operating cost, such as installing a large storage tank of 150,000 gals. capacity and to pump during an 8-hour period. Various schemes to pump electrically were also recommended.

Solving the Problem at Delphi Ind.

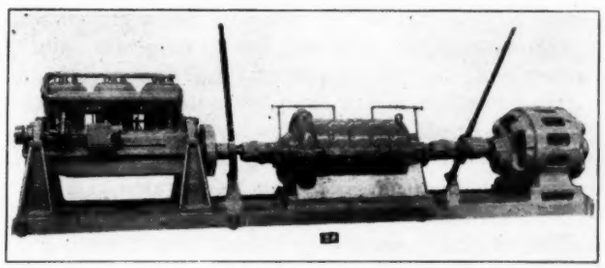
In the first place this tank alone would have cost 50 per cent. more than the actual cost of their final electric equipment, and the plant would have cost almost as much to operate as under the old method.

Among other methods considered were installing a new high duty steam pump, pumping by different types of electrical equipment, pumping with present equipment and installing a large elevated tank, cutting down the pumping time.

The original cost of operation with the old steam pumps was $4,827.50 per year. Using electric driven pumps, making the plant automatic and cutting out all of the labor, it was estimated that the entire yearly cost would be less than $2,000, or a saving shown of $2,800 a year, and with interest and depreciation considered, a possible saving of a little under $2,000 per year.

Factors to Consider

It is very important in these smaller installations to get proper estimates on the amount of water being pumped, as if this is not done and the consumption exceeds the estimate, there is likely to be disappointment on the cost of operation. It is necessary that the designer exercise good judgment and obtain all possible information on this subject, not only from the point of proper pumping



VIEW OF 6-IN. 6-STAGE MIDWEST DIFFUSER RESERVE PUMP FOR FIRE OR DOMESTIC SERVICE OF CITY OF DELPHI, INDIANA, DRIVEN BY 75-H.P. LINCOLN MOTOR OR 75-H.P. WISCONSIN GASOLINE ENGINE. PUMP DELIVERS 800 GALS. PER MINUTE AGAINST 231 FT. HEAD.

capacity, but also in order to get the most efficient pump, as on centrifugal installations if there is not the proper relation between capacity and consumption there is considerable loss in power. These matters should all be gone into very carefully.

Another very important item is the question of fire service. Any electric transmission line is subject to break-downs or mishaps for short periods, or the power plant may be out, and in such a case with electric drive the town will be left without water, except for such capacity as is available. Under the Delphi conditions this tank was only good for about 20,000 to 25,000 effective storage when full, and it must be remembered that the power might go off when the tank was at the low point, and it was therefore necessary that some reserve power be provided. In this case oil and gasoline engines were considered, and it was found that the gasoline engine fulfilled the requirements to better advantage than oil, while more expensive to operate it was quicker to start and was much cheaper and would only be used occasionally.

Selecting Reserve Power Units

A word of caution should be given in the selection of

Printed as insert to Municipal and County Engineering, Chicago, Ill., May, 1920.

such reserve power. It is better to pay a little more and get a slower speed engine. In some instances I know of engines operating for a number of days without an interruption, and if you have a bad fire you want something that will stand up to the work.

Owing to the current at Delphi coming from the electric railway this meant 25 cycle current and meant either a 1,500 speed or 750. In order to pump the amount of water desired, about 800 gals. per minute at 100-lbs. pressure, this requires a pretty sturdy engine. To run an engine of this size at the rate of 1,500 revolutions did not appeal to the writer at all. Our specifications therefore called for a speed of 750, and this required a 6-stage centrifugal pump, due to the low speed, but we believe the difference has been worth while. Of course, with 60-cycle current our speed could have been 1,200, and we believe this is getting close to the limit for good permanent operation as far as the engine is concerned.

New Pumping Equipment at Delphi

The plant at Delphi is arranged with two 400-gal. Midwest 2-stage diffusor pumps connected to 30 h.p. Lincoln motors, speed 1,440 r.p.m. pumping against about 60-lbs. pressure. These pumps are not connected in series, but are used for ordinary fires. The reserve unit consists of a Midwest 6-stage diffusor pump, good for 100 lbs. pressure at 750 revolutions. This pump has a 75 h.p. Lincoln motor connected with jaw clutch on one end, and on the other end for reserve power a 6 cylinder 5¼x7-in. Wisconsin gasoline motor complete with electric starter. In case of a break-down the gasoline engine can be operated either for fire pressure, in which case it can be speeded up if necessary, or it can be operated at a lower speed and used for domestic pressure in case the power is off. This engine is turned over about once a week for a short time. The generator for charging the battery is connected to one of the domestic pumps, so that the battery is always kept well charged, ready for starting.

Changing to Electric Service Saves Money

The entire cost of this work installed was about $11,000. By it, all labor has been dispensed with, and this amounted to $1,680 before the plant was started. The 1918 cost of coal amounted to almost $4,000 per year, or, to be conservative, for the year 1917 it was about $3,100; these two items of labor and fuel amounting to approximately $4,800. The actual cost of current to operate these pumps the first few months was about $40 per month. This was on the old off-peak 2-ct. rate, but after contracts had been let for the plant, the matter of rates was brought up by the Power Company before the Public Service Commission, and after adjustment the average cost per month will now amount to about $75, or about what they used to pay one fireman. This is the entire total operating cost of this plant, or about $900 per year. Therefore, the present operating cost is to the old operating cost as $900 is to $4,800, or there is almost $4,000 a year difference. Of course, to this must be added the interest and depreciation, which would amount to approximately $900 a year. It will therefore be seen that the changing to electric service has been a very good investment for the city of Delphi.

The Rate Question

On the matter of rates, this should be very carefully considered, as where a number of different published rates are available, the one that apparently seems to be the lowest does not always work out so. It has been the intention of the city to take advantage of the straight off-peak rates, but when the matter of rate readjustment came up the writer recommended the rate as under the demand charge, as this would save any trouble about operating under the off-peak.

In all the above calculations it should be remembered that a superintendent of water works is required and that he is still retained, and what slight attention the present pumps needs, such as oiling, is done by the superintendent but the plant requires very little attention.

Plant at Rochester, Ind.

Another plant, but slightly differently arranged, is the one designed by the writer for Rochester, Ind. This consists of two 500-g.p.m. DeLaval pumps and 40-h.p. G. E. motors and one 1,000-g.p.m. DeLaval pump and 60-h.p. motor. These pumps are arranged so that they can all be operated for domestic consumption, giving a total capacity of 2,000 g.p.m. This gives standpipe pressure and can also be used for fires, where pressure not over 50 lbs. is suitable. In case high pressure is required the two 500-gal. pumps are operated in series with the 1,000-gal. pump, giving 1,000 gals. at about 100 lbs. pressure. In this plant it was necessary to do something to replace the old machinery. The local power company made a proposition to pump all the water for $3,600 per year, and attend to the plant, and this contract is now in effect. The former cost of operation with the steam pumps was about $4,800 per year. This plant has as reserve its old steam pump and boiler. It would have been necessary for the city to have installed some kind of new equipment, and with the proposition made by the local power company the electric drive was thought more advisable. While the steam reserve does not allow a very quick starting up in case of accident with the transmission lines, in this case the possibility of power being out was small, as it is only a short distance to the local power plant, and any break in the transmission could speedily be located and repaired, and it was thought that the supply in the standpipe would be sufficient to tide over such periods.

Plant at Van Buren, Ind.

Another small water works plant in a town having a population of only 1,200 would be of interest, and mention is made of the town of Van Buren, which purchases current at 2½ cts. per k.w.h. for pumping purposes. Two triplex pumps were installed, each of 125 g.p.m. and geared to a 10-h.p. slip-ring motor. These pumps are both controlled by a special design of automatic control, having two regulators for each outfit. The pumps discharge into the main and are connected to a pressure tank of 5 ft. diameter by 20 ft. long. This system has about 9,000 ft. of mains, 18 fire hydrants, and the entire plant was installed for $9,500. The plant is operated by the town marshal, who is also the street commissioner. His water works duties consist of oiling machinery, and $20 per month of his salary is charged against the water plant. Power averages $15 per month, and the entire cost of operation, including interest at 5 per cent. and depreciation at 1½ per cent. is estimated at $1,085 per year. This shows that such a plant can be operated on a paying basis. The entire operation of the plant has been satisfacory in every way and the town is greatly pleased with its success.

COMPETITION BETWEEN MUNICIPALLY AND PRIVATELY OWNED WATER WORKS AT LIVINGSTON, MONT.

By Robert E. McDonnell, of Burns & McDonnell, Consulting Engineers, Interstate Bldg., Kansas City, Mo.

Livingston, Mont., with a population of about 8,000, located on the Yellowstone River, contended that its franchise to the privately owned water company expired in 1911, and, looking toward municipal ownership, the city had an appraisal made of the water works property and appointed its representative to confer with a representative of the water company with a view to arriving at negotiations towards purchase.

Private Company refuses to Negotiate

The engineers found the estimated cost of reproducing the property, $165,662. A further estimate was made of the cost of building a modern plant, new in every respect, which was $225,000. Every effort was made by the city officials to encourage negotiations towards purchase, but the company declined to confer with the city representative and scorned all efforts to reach any agreement, leaving the city with the only alternative of installing its own plant, in order that the city might procure proper fire service and filtered water, which the company declined to furnish.

The privately owned company's source of supply was the Yellowstone River, which at times is subject to pollution and in the spring months is very heavy in sediment. The State Board of Health made sanitary surveys of the Yellowstone River and recommended filtration, with chlorination, in order to procure safe water. The company declined to heed these suggestions, and the city, as a last resort, was compelled to install its own plant, in order to be sure of an abundance of good, pure water. But acting under the advice of engineers and rather than enter in a competitive business, the officials of Livingston renewed efforts to purchase the plant, even offering considerably more for the plant than an entire new plant could be built for, but without success.

The Municipal Plant

Following these failures to purchase the existing plant, the city voted $260,000 bonds for a complete new plant, which provided for a modern filtration system, using the Yellowstone River as a source of supply, but locating the plant above the surface drainage of the city of Livingston. One of the strong reasons for building the municipal plant was the necessity of procuring filtered water and a plant so located that the surface drainage of Livingston would not enter the river above the intake.

Comparison of the Two Systems

Although the preliminary steps were taken in 1911, it was approximately nine years later before the plant was placed in operation. Injunction suits against the bond election, against the selling of the bonds, against letting contracts, and other steps, were constantly brought by the company, entailing endless litigation, but eventually the city plant was placed in operation. Now, after one year's operation, it may be of some interest to note a comparison of the two plants.

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Private Plant	*Municipal Plant*
Number of miles of mains, 10.5.	Number of miles of mains, 14.55.
Number of fire hydrants, 96.	Number of fire hydrants, 168.
Storage reservoir capacity, 415,000 gals.	Storage reservoir capacity, 1,000,000 gals.
Average domestic pressure, 35 to 45 lbs.	Average domestic pressure, 70 lbs.
Water used without filtration.	Water filtered, modern mechanical filters.
Number of water services before municipal plant operated, 1,330.	
Number of services one year after municipal plant began operation, 300.	Number of water services at beginning of operation of municipal, 0.
	Number of services one year after beginning of operation of municipal plant, 1,180.
Total appraised value, $165,662.	Total final construction cost, $255,538.
Report of water tests shows doubtful quality and high turbidity.	Report of water tests shows negative, with safe water for all domestic uses.

It will be seen from the above comparison what patronage will be given to the average municipal plant placed in operation under similar conditions. It is estimated that the gross income for the coming year will be approximately $35,000, and the general public express entire satisfaction and approval of the operation of the municipal plant. The property owners have enjoyed a large reduction in their fire insurance rates, but the phenomenal success of the municipal plant is largely attributed to the furnishing by the municipality of a supply of pure, clean, filtered water at a pressure that is satisfactory for all domestic requirements.

The privately owned plant continues to operate on part time with a reduced force of employes. Some of the friends of the private company have expressed the opinion that the privately owned plant will cease to operate before the close of the year.

The above comparisons are not offered as any inducement or encouragement for cities to build or operate competing plants. This course was advised against at Livingston and every effort was made by the municipality to avoid a competing plant, but the city being forced into this procedure, it is of interest to see the outcome of the establishing of a competing municipal plant.

Much of the success of the municipal plant is due to the energetic activities of J. A. Cortese, the superintendent of the water committee, consisting of J. W. Fryer, A. J. Huffer, and its chairman, H. S. Masters. Each year the city of Livingston re-elects officials in thorough sympathy with municipal ownership, and the present Mayor, Lewis Terwilliger, shares these views.

The engineers representing the city in the appraisal and in making plans and estimates for the new plant and its supervision to completion were Burns & McDonnell, Consulting Engineers, Interstate Building, Kansas City, Missouri.

RATIONAL METHOD OF DEVELOPING A SHALLOW GROUND WATER SUPPLY

By W. D. P. Warren of Miller, Holbrook, Warren & Co., Civil Engineers, Decatur, Ill.

One of the most interesting and perplexing problems which an engineer is called upon to solve is that of developing a supply of water from shallow-ground wells. To the public the big impounding reservoir, with a "visible supply of water," is a real engineering accomplishment. However, at times, it may be exactly otherwise.

The writer has given some study to the development of both impounded and well supplies and fully appreciates the necessity of the impounding reservoir under certain conditions. The plan of developing water from wells is an extremely old one, and yet one on which the best technical advice should be obtained before final plans for developing an impounding reservoir are adopted.

A few years ago the writer was called upon by the officials of Witt, Ill., to assist them in developing a supply of water, and the difficulties encountered in the development of this supply led to a somewhat more extended study of well supplies than might otherwise have been thought necessary. In the development of the supply at Witt, valuable support was given by the Mayor, Dr. Charles Lockhart, who, being a professional man, realized the value of professional services in this matter, and gave every assistance possible.

A Typical Problem

Witt, Ill., is a city of 3,000 population, and inasmuch as the conditions encountered there are more or less typical, it will serve to illustrate the method of developing water from shallow-ground wells, to which it is desired to call attention.

The first information given the writer at Witt was that the City Council as a whole, wanted a visible supply of water, also that there was no chance for a well supply, as both mines in that vicinity were dry, and further that the only wells near the city were shallow and showed no promise of an adequate quantity.

Further investigation disclosed the fact that the Engineers for the State Water Survey had been over the ground several years previously and had made a brief, although valuable report.

We quote below an extract from the Letter of Transmittal of Mr. Paul Hansen, Engineer, and are pleased to call attention to the fact that in this letter he pointed a way to the proper solution. The date of this letter is June 4, 1913:

"At present there are no available data which would point to a successful water supply, but it would seem worth while to prospect by means of test wells, especially toward the northeastward, at a distance of several miles, where the city of Nokomis has been very successful in securing an abundant supply of water from wells penetrating sand and gravel in the drift at a depth of about 40 feet."

Quite contrary to the advice of the State Water Survey, a number of the officials determined to undertake the development of an impounding reservoir, the thought being that a well supply was too uncertain. Under these circumstances the investigation of a surface supply was begun.

Impounded Supply

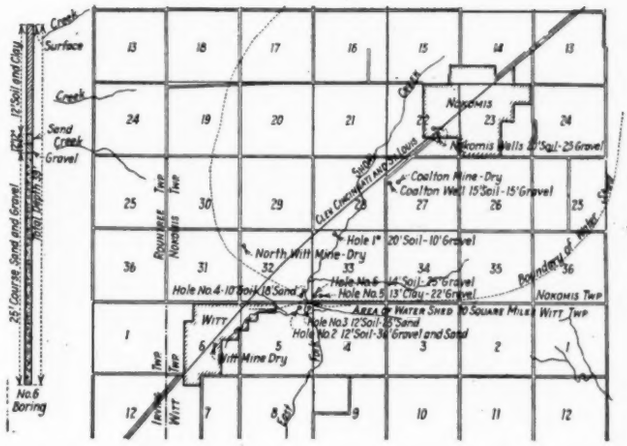
Surveys were made on a number of sites considered feasible, but as the territory about Witt is comparatively flat or rolling, no site was found nearer than 4½ miles from the city. The drainage area here was considered sufficient; and this project appeared feasible, although a filter plant would have been required for the treatment of the water to render it suitable for domestic use.

The surveys and estimates on the various sites were shown in a report covering the investigations for the city.

The estimated cost of the supply from the impounding reservoir, delivered to the city, and not including distribution system, was about $125,000.00. This amount was greatly in excess of any figures the officials had in mind for such a supply, and it was no doubt due in a measure to this fact that they were led to adopt the recommendations contained in the report that a full study be made of a possible well supply before deciding to adopt any plan for an impounding reservoir.

Investigation of Well Supply

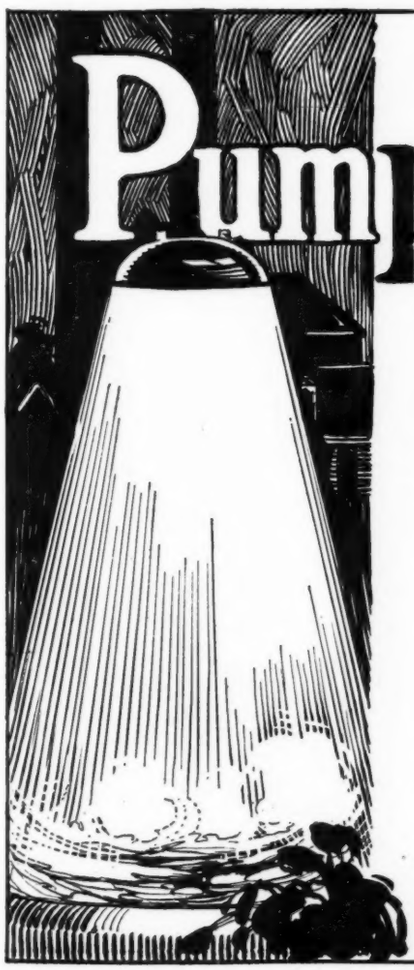
In undertaking to develop a well supply the writer was limited in the beginning by a resolution of the City Council to the effect that not to exceed six wells should be drilled. Several days spent on the ground disclosed the information that the mine in the south part of the city was dry, also that the mine about one mile north of the city was dry, and that the closest known well proposition was at Nokomis, about 4½ miles northeast of Witt. A visit was therefore made to Nokomis and valuable information secured from the officials in charge of the plant at that place. The Nokomis supply is from six 6-in. wells, about 40 ft. deep, the wells being driven into the drift and passing through 20 ft. of soil and clay and 25 ft. of coarse water bearing sand and gravel. The gravel appeared to be of a grey or bluish color with little silt or clay in it, being of similar color and character to the material from which the supply at Bloomington, Illinois, is secured.



DATA DERIVED FROM GROUND WATER SURVEY IN VICINITY OF WITT AND NOKOMIS, ILL.

At this time it was considered that the supply at Nokomis, being in a wide flat valley, might be found further down, in a general southwesterly direction toward Witt, but east of the closest point of the city limits by about 3,000 ft.

This theory that the gravel deposit might continue down the valley was borne out in a way by information that in sinking a new mine southwest of Nokomis, con-



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siderable water had been encountered and it had been found necessary to change the location of the proposed mine to a point somewhat further east from the general lines of the valley. A conference was held with Mr. Sjoblom, Acting Chief Engineer of the Department of Public Health at that time, and much credit is due him for his excellent advice in this matter.

The statement of Mr. Sjoblom was to the effect that if it was necessary to go 4½ miles for a supply from an impounding reservoir and then treat the supply, it would be much more practicable to develop a well supply, even if necessary to go somewhat beyond the 4½ mile limit. In other words, a real tangible starting point was established. Inasmuch as the supply at Nokomis had been very thoroughly tested over a period of years and was known to be adequate, it was therefore seen that Witt could at once get a well supply from Nokomis, only 4½ miles distant, and thereby effect a very substantial saving over the method of an impounding reservoir.

Drilling

The location chosen for putting down hole number 1, was in about the center of the valley, two miles southwest of Nokomis and roughly in line with the Nokomis wells and the mine test hole one mile southwest of Nokomis, as above referred to. At a depth of 20 ft. a very excellent quality of water bearing sand and gravel was encountered and was found to be 10 ft. in depth, giving a total depth of 30 ft. for the well. The well driller called attention to the ease with which the well casing and drill seemed to go through this gravel deposit and stated that the flow of the water appeared to be extremely "free." This gravel was of a greyish or bluish color.

Hole number 1 indicated an adequate supply of water for Witt at a distance of only about two miles from the city, however, it was thought that the deposit would probably be found down the valley and closer to the city limits.

In selecting a site for hole number 2, it was decided to choose a point on the west edge of the valley, and in so doing, the hole was located within a short distance of a little branch entering the valley, and as a result considerable silt and clay were found in the sand, probably due to action of the currents caused by this small branch entering the valley proper. Furthermore, the sand did not run as coarse as in hole number 1 and was of a yellowish color. It was concluded that this hole was on the western edge of the deposit, for it was very similar to holes put down about that time at the mine located one mile south of Nokomis above referred to, which was known to be east of the main gravel deposit.

Hole number 3 was about 200 ft. east of number 2, but showed much fine sand; also holes number 4 and 5, which were about 500 feet north of holes number 2 and 3, showed more or less fine sand. However, hole number 5 showed better sand and, as it lay more nearly in the center of the valley, it was concluded that further drilling would locate the coarse material where the flow through the gravel would be more "free."

Considerable pressure was brought to bear at this time to induce the city officials to stop such "useless waste of money" in drilling holes out in the country and to either put down some holes in Witt, where the city owned several vacant lots, or abandon the drilling entirely.

This attitude at Witt was anticipated and cleared up only by a careful statement of the methods being followed in the development of this supply.

It is proposed in this article to refer to the method of developing the supply from shallow wells as the Rational Method, for as in the case of sewer design by the Rational Method, opportunity is given for exercise of judgment and experience, as well as for the application of fundamental engineering principles.

Rational Method

In the study of the problem at Witt careful search was made of available works on water supply from wells, and only a very few authors were found who gave a clear and reasonable method of procedure for the development of a shallow-ground water supply.

Hubbard and Kiersted in their book, "Water Works Management and Maintenance," have set down in simple language the following fundamental considerations which govern:

"No more water can be continuously taken out of the ground than goes into it.

The yield of the ground-water is dependent upon the character and extent of the catchment area and depth of the saturated water-bearing material.

"The velocity of flow of ground-water depends upon the character of material through which it must pass in gravitating from a higher to a lower level.

"The stability of the ground-water supply depends upon the three considerations above stated as well as upon available ground storage at the point selected for developing the water-supply."

From a study of the accompanying sketch it is seen that the area of the water shed northeast of Witt is 20 square miles, a sufficient catchment from which to secure water for a much larger city.

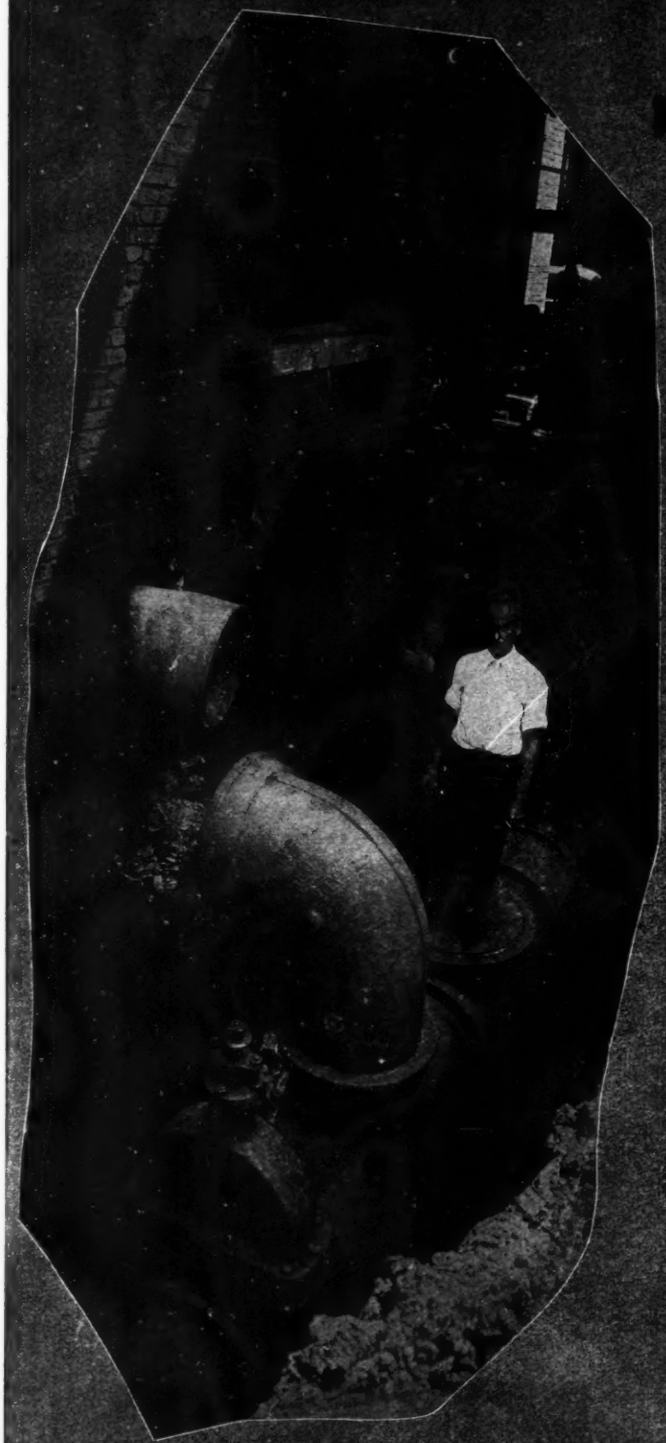
Evidently then we have a much greater promise of an adequate supply from this valley than from any point nearer the city with a less catchment area, assuming that we expect to develop a shallow-ground supply.

Furthermore, we see that the yield is dependent upon the depth of the saturated water bearing material. With the large number of holes put down on this area the average depth of saturated water-bearing material was determined, and was approximately 20 ft.

The velocity of flow is governed in a large measure by the size of the sand and gravel particles, the coarse material permitting the water to flow much more freely. As stated above, the material ranged in size from fine sand to particles of gravel 1-in. in size, the samples taken from the different holes giving positive information on this point.

The available ground storage in this case was determined by learning the length, width, and depth of the saturated water-bearing material, computing the storage in gallons on the basis of one-third the volume of sand being void space, and also on the basis that one-third the average annual rainfall, or 12 ins., was the available underground run-off. "Water Works Management and

Buried Treasure



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Maintenance" by Hubbard and Kiersted, gives additional information on this point.

It is thus seen that the elements of uncertainty as to the well supply have disappeared, that we have definitely determined the water shed area, the capacity of the underground storage basin, the size and quality of sand or gravel bearing deposit and the rate at which it may be expected that water will flow through the deposit to the wells.

It is interesting to note here that engineers too frequently fail to cite their authority for engineering practice which they propose. The average water works official is very slow to dispute an engineering principle laid down by an authority on the subject, just as he is slow to argue when his attorney cites some legal principle and presents his Supreme Court decisions or his other proper authorities.

Testing Supply

A most important feature in the development of a well supply of water, as considered by some authorities, is a long continued pumping test, covering a period of several weeks or several months. While a sparkling stream delivered from a well for several weeks will look quite convincing to many officials, and in fact may prove of some value in a study of the supply, it is probably more often misleading than valuable. As an illustration, assume we desire to test a well by pumping at a rate of 1,000,000 gals. per day for 30 days, also that the deposit from which the supply is furnished has a storage capacity of 60,000,000 gals., with a somewhat limited water shed area. It is readily seen that the well might be pumped the full 30 days and appear to be strong at the end of this period, when as a matter of fact an additional 30 days' pumping would exhaust the supply. It is readily apparent, therefore, that a pumping test alone cannot be conclusive.

The pumping tests at Witt were carried on over a period of about two weeks. However, it was frankly stated to the officials at the time that a pumping test over any considerable number of days was not necessary in view of the previous knowledge of the fundamental elements which controlled the supply. During the time tests were being made, Mr. Habermeyer, Acting Chief Engineer of the State Water Survey, was present and the following extract from his report of Aug. 6, 1918, to the officials of Witt is here given.

"The test of the well indicated a large quantity of water available. A yield of 70 gals. a minute was secured when lowering the water level in the well about 8 ft. to a depth of about 14 ft below the ground surface. (The well was 6 ins. in diameter, and equipped with a No. 20 Cook screen, 6 ft. long.) With the greater area of openings in screen or greater lowering of water level a greater yield would be secured. The ground water level was lowered but a little at a distance of 20 ft. from the well."

Special Features of Witt System

The final plan at Witt was to construct a circular concrete pump house, 22 ft. in diameter, built over two 10-in. wells spaced 18 ft. center to center, the pump house being set 10 ft. in the ground in order to reduce the lift of the centrifugal pumps. There will really be only about 6 ft. of lift for the pumps under present conditions, due to the level of the water in the ground.

Another feature of interest is the reinforced concrete water tank, built on the highest point in the city, the tank being 20 ft. in diameter and 100 ft. in height, the upper 30 ft. having 70,000 gals. storage capacity.

Two pumping units have been installed, being electric motors, either of which has sufficient capacity to take care of normal requirements.

The writer believes it would have been a better plan to have installed possibly one electric motor and one automobile-type gasoline engine, as auxiliary source, each connected to a separate centrifugal pump.

The total cost of the supply system, including wells, pumping station complete with equipment, 8-in. cast iron pipe line to city limits, a distance of 3,000 ft. and the 70,000 gal. reinforced concrete water tank was less than $25,000 or about one-fifth the estimated cost of an impounded supply.

The distribution system was let as a separate contract in 1919, and cost approximately $10,000 per mile, including valves and hydrants, the total cost of the distribution system being about $70,000 for the seven miles. It is thus seen that the entire cost of both the supply and distribution systems was only about 75 percent of the estimated cost of an impounded supply alone.

Value of Rational Method

Careful examination of the location of known shallow-ground wells with reference to area of water shed, will demonstrate the proposition stated by Hubbard and Kiersted that "The yield of the ground water is dependent upon the character and extent of the catchment area and depth of the saturated water-bearing material."

A most interesting illustration of this is found at Bloomington, Ill., where the supply is secured from shallow-ground wells. Here the water shed area is only a few square miles at most, while the depth and area of the saturated water-bearing material is necessarily somewhat limited. Year after year desperate efforts have been made there to secure more water from this saturated water-bearing material, and yet the proposition that "no more water can be continuously taken out of the ground than goes into it" has never been fully recognized in the study of the situation, unless possibly within the last months.

We refer again to Hubbard and Kiersted: "Shallow-ground water supplies are usually developed from sand and gravel deposits in the valleys of creeks and rivers." In this connection, what are the limits of the deposit at Bloomington? Does it continue down the valley to a point where the catchment area and the depth of deposit are sufficient to supply a future city of 100,000 people? What is the character of the gravel further down the valley? These are important factors, and could be definitely determined at very small expense.

Recently there was witnessed an effort by a city of 5,000 population to secure a shallow ground water supply from wells located on a catchment area of only about one square mile. Twelve or fifteen wells were put down on one 40-acre tract, and pumping of water in one well lowered water in all the others. Was this a Ra-

tional Method of Water Supply Development? We hardly think so.

In another city a test was made on a shallow well, driven into about 11 ft. of coarse gravel and the supply was pronounced a failure, when as a matter of fact there was a continuous deposit of sand up and down the valley, and available records of the State Geological Survey showed that there was a deposit of 90 ft. of gravel within a quarter of mile of the well tested, with about 50 square miles of catchment area above it.

These are only a few cases which point to the necessity of careful study and intelligent application of the fundamental propositions which govern the development of shallow-ground water supplies.

Goodell, in his book, "Water Works for Small Cities and Towns," has also given us valuable information on this Rational Method in the following language: "The amount of water that may be obtained from deep and shallow wells is so often over-estimated that it is necessary to call attention to the fact that the quantity available depends on the *same* conditions as the amount of surface water, that is, the extent of the catchment area, the rainfall, the proportion of the rainfall entering the ground and the capacity of the basin to hold ground water."

It will, of course, be borne in mind that where a deep or artesian well is to be developed, a careful geological examination will be necessary.

Turneaure & Russel in "Public Water Supplies" refer to collecting areas for ground-water as follows:

"Deposits of porous material in old lake and river beds often furnish very good collecting areas for ground-water, and many of the shallower ground-water supplies are from such sources. These deposits are usually covered by other and less pervious strata, and indeed often consist of a series of strata alternately of a pervious and non-pervious nature. This is particularly true of the lacustrine deposits in the basins of the Western mountain region. Old river channels filled with debris of a porous character give rise to veritable ground-water streams. These may be located some distance from the modern streams, or may at places coincide with or underlie them, forming porous, gravelly beds.

"Examples of such ground-water streams are very numerous. Leipsic, Germany, is supplied from such a stream about 2 miles in width, 40 ft. thick, and having a fall of about 6 ft. per mile. The covering stratum is 6 ft. thick, and the velocity of flow is estimated at about 8 ft. per day. Pueblo, Colorado, is supplied with water from a gravel bed 66,000 sq. ft. in cross-section with an average depth of 14 ft. and a length of 25 miles. Deposits of sand and gravel in the drift are often of considerable extent, and furnish many ground-water supplies, but such deposits are apt to be very irregular in character and uncertain in extent. They occur as accumulations in former stream-beds and also in the form of thin, irregular strata, sometimes of considerable extent, lying for the most part in valleys and covered with more or less clay."

It occurs to the writer that we too often fail to make our examination sufficiently broad to learn the true location and character of the collecting area, from which we might secure well supplies.

It is a matter of record in this state, as it is also in many others, that we have sand and gravel deposits scattered over a greater portion of the area, that they follow in a general way the old original valleys, sometimes conforming to the outlines of the present valleys; and it is the belief of the writer that a careful application of the principles above outlined will enable a great majority of our cities and towns to develop water supplies from such gravel deposits in an economical manner.

Conclusions

In conclusion it is desired to direct attention to the following propositions.

1. With a saturated water-bearing material located on a catchment area of proper extent a shallow-ground water supply will ordinarily be developed at far less expense than an impounded supply.

2. The radius of investigation for shallow-ground water supplies should be increased so that it shall include not only the city limits but extend for a distance of 5 or possibly even 10 miles beyond the city limits, depending on local conditions, and the availability of an impounded supply.

3. The quality of water secured from one test well in a valley may be entirely different from that in another well in the same general region, due to deposits in the original valley produced by the action of currents. Intersecting creeks and branches will very often show a marked influence on the character and quality of the saturated water-bearing material, and the water contained therein.

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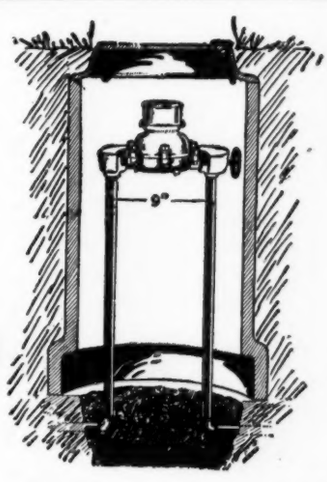

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4. The quantity of water available from a saturated water-bearing material should be determined for various cities as fully as has been done in the case of Pueblo, Colorado, and comprehensive studies of this character should be made a matter of public record, in order that the fullest use may be made of them by other towns and cities.

The Rational Method of Water Supply Development herein discussed does not present any new theories, but does contemplate the application of known engineering principles along such broad, comprehensive lines, as judgment and experience may dictate.

Acknowledgment

This paper by Mr. Warren was presented at the 1920 annual convention of the Illinois Section of the American Water Works Association.

WATER WORKS REQUIREMENTS FOR SMALL AGRICULTURAL VILLAGES

By Edgar A. Rossiter, Consulting Civil Engineer, 127 N. Dearborn Street, Chicago, Ill.

One of the first ear-marks of progress in the small community is the installation of modern water works. It is the forerunner of home conveniences that tend to hold the boys and girls in our rural districts. The lack of modern conveniences has depopulated many a farm and village in favor of the larger cities.

One of the greatest educators along these lines has been the mail order catalogue. Its highly illustrated bathroom scenes, showing snowy white fixtures, have created a desire for something better than the rural districts afforded.

The individual air pressure system, with its freely flowing water, has silently been another factor in awakening the village to the necessity of a public water supply. There are still some villages in our central states of a population of over one thousand inhabitants that have no public supply system. There are many hundreds of prosperous villages of over 500 population that are without a public water supply for fire protection and domestic uses.

In Illinois, the laws are extremely favorable to the installation of a municipal water system, and to one who knows the ropes the plan is simple.

Sources of Supply in Illinois

The first consideration is the source of supply, which varies with the geological formation. Where the glacial drift has deposited large beds of sand and gravel the shallow well, ranging in depth from 100 to 200 ft., has give a sufficient supply which is practically bacteriologically and chemically pure and is reasonably soft.

A fault in the limestone formation at a depth of 200 to 400 ft. has sometimes given a fairly satisfactory flow. In some localities the mineral content is such that the use of the water is prohibitive. The peculiarity of the supply is such that at first there is but a faint taste of sulphur, but as the years go by and the pumping continues, the iron pyrities, sulphur and oxygen create a mixture that is not drinkable. The water is also hard and cannot be used in boilers or in the laundry.

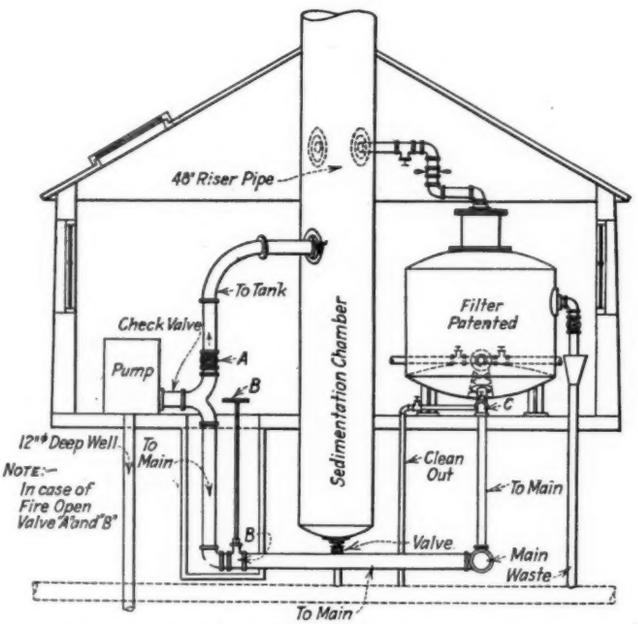
The deep wells range in depth from 1,100 to 1,800 ft. where a water of varied degree of hardness is obtained, and the mineral content is such that frequently it is useless for boilers or laundry. The supply coming from the St. Peter and Potsdam sandstones are good drinking waters, though hard. Below the Postdam a salt is often found which if drilled into will convince the owner that a consulting engineer would have been a saving proposition, as an expert would have prevented such a catastrophe or would have been able to plug the hole at the proper place to eliminate the salt.

The surface water from creeks, rivers and lakes gives a supply subject to more or less contamination, often requiring sterilization, coagulation or filtration.

The Financial Question

Concurrent with the source of supply the financial question is of vital importance. Proper rates must be charged to place the plant on a paying basis so as to retire the water certificates when due. In designing a small water works plant the element of economy is more vital than in larger installations, in order that financial failure be prevented.

Fire protection and an inherent demand, or hope, for a reduction of insurance rates, go hand in hand with the



COMPACT WATER SOFTENING AND FILTRATION PLANT FOR AN ILLINOIS VILLAGE.

economy of design, and the proper fire protection should be the governing factor in the distribution system, the spacing of valves and hydrants, together with the proper equipment for the power station.

Power station and equipment depend on many phases of the construction. First, the designer must have in mind that a reduction of fire insurance rates means in fifteen years a saving of the cost of the plant, and that in order to obtain such reduction the Board of Fire Underwriters must approve of the design of the plant. Second, one must consider maintenance cost or yearly upkeep. Third, uniformity of power supply and the dependability

on its operation when needed. Fourth, the installation should be as free of complicated equipment as possible.

Where the village covers a very closely settled tract, not spread out over a large territory, the air pressure system has given satisfaction, provided the tanks are large enough and the power so arranged that oil engines and electric motors can be used in case one or the other breaks down.

The most efficient and economical installation, however, for a village is the tower and tank, ranging in capacity from 40,000 to 100,000 gals., elevated from 100 to 120 ft. Pumps operated by oil engines, with an electric motor as auxiliary power, the pump working directly into the tank and by-passed into the main for fire use. The tower and tank system having a pressure of 50 lbs. and a capacity of 40,000 to 100,000 gallons, is always ready in case of fire. Even if the current is shut off the operator still has the tank full to work on.

I have often wondered what some air pressure systems, electrically operated, having small tanks, would do if lightning struck the town starting a big fire and the Public Service Company cut off the current, as is frequently done.

Pumps, either deep well or surface, should be of the highest mechanical efficiency obtainable, using if possible oil and electric motor for power and should have automatic control.

In a plant recently designed where a hard water, having certain mineral content, including iron, is obtained, the water is aerated during pumping, a softener injected, the precipitates falling to the bottom of the standpipe as a settling basin where a blow-off valve is placed. The supply is taken out of the standpipe 10 ft. above the bottom, passing through a filter (except in case of fire), the entire treatment cost adding but a small amount to the investment.

The distribution system depends upon the make-up of the town, location of schools, churches and buildings and the probable increase in size of the town. The actual consumption of water for domestic purposes could possibly be supplied through a 4-in. pipe, but for fire protection the size of mains will depend upon the number of streams estimated to be necessary, the distance from the plant and friction losses, and the sizes put in will run from 8 to 12 ins. in diameter with 6-in. laterals.

Valves should be placed so that certain portions of the mains can be cut off for repairs without closing off the entire system. Hydrants should be spaced not farther than 330 ft. apart for good fire protection. Mains, valves, hydrants and all other equipment should be of standard make and of the very best of its kind or the repair bills will prevent the payment of the original installation.

In the small town water works plant, electric and oil engine power should be used, as this will reduce the operating expense to a minimum, for in many towns the marshal attends to the station, reads the meters and makes out and collects the water bills.

STEAM POWER PLANTS FOR PUMPING STATIONS

By P. J. Kiefer, Asst. Professor, Steam Engineering Department, University of Illinois, Urbana, Ill.

In 1900 the Allis engines at Chestnut Hill Pumping Station, Boston, gave a duty of 157 for the engine only, the then lowest coal consumption of 1.06 lb. per indicated horse-power hour and an (estimated) overall plant duty of about 125. Since this date my impression is that there has not been any considerable gain in reciprocating plant efficiency except in cases of the use of the Uniflow type of engine. Lacking quickly accessible actual test data I have estimated that, using the highest type of Uniflow engine with high pressure and superheat and with a high grade of boiler installation and operation, the over-all duty figure might perhaps be brought to 135 or 140. It does not seem probable that any considerable gain over this may be expected with the reciprocating unit.

The Steam Turbine

The steam turbine has, of course, made a very spectacular advance in the electric power generation field during the last several decades. By the use of higher pressure, temperature and vacuum it has in the larger sizes obtained somewhat higher heat efficiency than that afforded by even the better class of reciprocating engine, although little, if any, better than that available with the Uniflow engine. The extremely rapid and complete displacement of the reciprocating engine by the turbine in this field has been due, however, not so much to any great gain in heat efficiency as is popularly supposed, as to its great economic advantages, such as the possibility of enormous concentration of power capacity into simple machines occupying small space, costing less initially and less for operating labor, all highly important factors in a plant operating with the relatively low load factor of the usual electric station. Its introduction in this field has again been co-ordinate with the development of the high speed electric generator.

Its advance in the pumping station has been much less rapid due to two or three basic and, to my mind, quite legitimate reasons. First of these has been perhaps the much less rapid expansion of pumping station loads, without the necessity for hasty and extensive increase of plant capacity such as been experienced in electric power generation. This condition would tend to support any inertia which might reasonably be anticipated in so old and well established an industry. Another reason has been that the efficiency of the centrifugal pump has failed to measure up to that of the high grade reciprocating pump, thus counterbalancing any gain that might be made otherwise by the use of the turbine. Again, first cost and the resultant fixed charges have not been such important elements on account of the very high load factor available in the majority of pumping plants. This has further made it possible to obtain the best of efficiencies with the standard apparatus and let it be said to the everlasting credit of the pumping station designer and operator that they have taken excellent advantage of their opportunities and it has usually been they who have set up the record toward which other engineers might strive.

Turbine and Centrifugal Pump

However, returning to the question of the use of the turbine and centrifugal pump and attempting to look into the future, it does seem probable that their introduction in the pumping station field will be continually more rapid. Reliable authorities predict the early commercial development and use of the 500-lb. boiler with 250 or more degrees of superheat. Turbine builders claim that under these conditions a turbine efficiency as high as 85 per cent. of the theoretically ideal efficiency may be obtained. Making high but not unreasonable estimates it appears that with such apparatus a plant duty of 150 might be obtained. It does not seem likely that the pumping station engineer will sidestep this opportunity, especially in the face of the rising cost of fuel. However, even before such time he may already have accepted the centrifugal pump, either turbine or motor driven, for other quite positive reasons, or again he may have taken the advantage of the higher efficiencies of the internal combustion engine.

Fuel Conservation

In all of this we have been looking at the basic fuel conservation problem from a rather narrow viewpoint. We have been reading and hearing so continuously of the necessity for fuel conservation that some with efficient plants may have become tired of it. I do not wish to be pessimistic in this connection, but it nevertheless seems true that should we in the future maintain the same annual rate of acceleration in our consumption of solid fuels as we have in the past century our higher grade fuel coal, will be exhausted in a very few years and all of our solid fuels, including the lignite and peats, would be used up in another century or two. Our crude oil supply is estimated to be about 50 per cent. exhausted already after only a few years' use and with rapidly increasing production at present. I anticipate that necessity and ingenuity will combine to decrease this rate of acceleration in fuel consumption and the above figures are extreme, but at the least the soaring coal and oil prices can hardly fail to drive home the idea that some sort of changes are approaching.

Some may have read in the recent technical press of the "super" power generation project seriously proposed for the Atlantic coast industrial zone, involving the elimination of all the less efficient small plants and plants without heating load with the concentration of electric power generation into enormous plants in the mine regions and at strategically placed water front locations, all coal to be given perhaps a preliminary by-product treatment and all available hydraulic power sites to be developed. An annual saving of $300,000,000 is estimated (Breckenridge). Such a scheme is not at all visionary and if developed might clearly be expected to affect vitally the policies and procedure of even the efficiently operated pumping plant which is located at some distance from the mines. I believe all of us realize the quite sizable loss of ultimate thermal efficiency and great loss of economic efficiency in having some 28 per cent. of our railway transportation engaged in hauling coal here and there about the country for us to waste far too often in a shamefully inefficient plant.

We have been speaking of high efficiency plants and of hypothetical plants giving a duty of 150. We take pride in our prime movers which transform into work 75 per cent. or more of that portion of the energy in the steam or gas which is theoretically available for such transformation. Likewise we are proud of the boiler with 75 per cent. efficiency. Let us not forget that in the very process of combustion at high temperature and subsequent partial absorption of the heat into much lower temperature steam we make absolutely unavailable for power generation purposes about 75 per cent. of the original energy in the fuel. The internal combustion engine is some better but not a whole lot. Unfortunately any of our present devices for power production from the energy of fuel basically are distressingly inefficient, but they are all we have and we must make the best of them. Would it have been any more visionary several centuries ago to have predicted the modern locomotive, turbine, aeroplane, wireless and innumerable other miracles, than it would be now to predict the discovery in no great number of years of some simple scheme for transforming the chemical energy of fuels directly to electrical energy without the wasteful intermediary combustion and engine, with perhaps 90 per cent. instead of 25 per cent. efficiency?

The foregoing is the major portion of the address delivered by Prof. Kiefer at the recent annual convention of the Illinois Section of the American Water Works Association.

CONSIDERATIONS AFFECTING THE DESIGN OF SMALL WATER WORKS

By J. Q. Wickham, Consulting Engineer, 300½ Main St., Ames, Ia.

To the average engineer and city official the designing and planning of public water supply works for the small cities and towns is of prime importance, and the present article discusses the major considerations affecting the design of such works.

First, Locate the Water

The first and most important matter of course is the choice of supply, without which any plant or system is a failure, and in the estimation of the writer, this is the most important step to be taken. There seems to be something wrong about the idea of procedure in this matter, owing it may be to too much promotion upon the part of some supply man, engineer, or some other interested agent, which should not be so. One of the biggest excuses most parties have for getting at the work in a wrong way is that in most cases a bond issue must be put through and a general plan and estimate must be given to show the voter why he should vote for a water supply system. This may be all well and good, but even though a bond issue has passed it would appear that before any final plans are drawn the matter of the water supply should be ascertained. The writer has in mind at the present moment a town that has a new complete wa-

ter system, tower and tank, pumps, motors, etc. all installed and not a supply in sight. Had the town made sure of water before expending money for the elaborate system that now in any event must be altered to meet the change in location of the supply, much time and trouble might have been saved. Today, they are putting down a well some two miles from town, and if the water supply proves adequate the system as installed is exactly opposite to what it should be. If this was the only case where the matter of the supply had been overlooked it might not be so serious, but there are many other examples of the same kind. It would appear therefore that the first and most important matter should be the obtaining of a good and adequate water supply, making thorough tests and investigations in advance of expending money for any expensive pumping and distributing system.

What Constitutes an Adequate Supply?

To some of us the matter of what might constitute an adequate supply would appear easy, while to others it might seem vague. On account of this it may be necessary to draw a few examples of what constitutes an adequate supply. For instance, a small town has in one section an excellent quality of water for small drilled wells delivering a maximum of 30 gals. per minute, while in another portion of the town a lower quality of water from a gravel bearing strata, supplying a maximum of 50 gals. per minute. What would be an adequate supply if the town required 30,000 gals. per day for domestic use, and a public utility plant in the way of a canning factory requiring 110,000 gals. per day?

It can readily be seen that one small well delivering 30 gals. per minute would not supply a maximum of 140,000 gals. per day. Many of the citizens in that section of the town, with the good quality of water, having no conception of the amount of water required, declared that their wells could not be pumped down (having used them only for house purposes) but upon test these wells were found to supply only the 30 gals. per min. as before stated. From the tests it was found that certain wells could be pumped without affecting others nearby. Furthermore, while the supply from individual wells was limited, they stood up well under the test, and as the water came from rock formation, only a little more than 100 ft. from the surface, and stood at a level of 15 ft. from the top, it was recommended that seven 6-in. wells be driven cross-wise of the vein, 25 ft. apart connected together at the 15-ft. level into one central pump-pit 15 ft. deep, and there attached to a 100 gal. deep well type of triplex pump. It may be somewhat out of the way to go into specific detail in this one instance but the object is to show that the matter of the supply should be carefully thought out in case there is any doubt as to quantity or quality. In some towns it is impossible to get the required supply without going to a great depth and even then it is of poor quality. Other towns are required to go several miles distant for a supply, to natural springs, water bearing gravel, or streams. It must be borne in mind, therefore, that even though the population is clamoring for action, the engineer and council should make sure of their supply before final plans are to be made.

The Amount of Territory to Be Served

The details of the final design are, of course, of considerable moment and some of the more important details will here be given. One of the first things in the matter of the design, after the source of the supply has been settled upon, is the ultimate amount of territory to be served. This is of vital importance for the reason that even though only a portion of the system be put in at the beginning a comprehensive design is necessary to provide for future adequate and proper extensions. As an example of lack of a good general design and plan it is only necessary to go into almost any small town or city and note where extensions have been made from the nearest point, going in one direction, for a block or two, then in another, making a zigzag line often running by property that will never need any service. A comprehensive plan, therefore, should be settled upon and carefully adhered to regardless of the desires and whims of some interested property holder.

The manner of laying out the mains often gets but little attention and this should be impressed more fully on the mind of the party making the plans. Not that the parties interested have not felt that they were doing the very best by the city or town they represent, but because the ultimate result of their work was not clear to them. For instance, there have been many systems of piping laid out with the idea of fire protection as the real object, and the matter of service to the individual property holder not once considered. As an example of this the attention of the reader is called to a town which had a complete water works system and an exceptionally good fire protection, but it was so arranged that not more than twenty families could get water service in their homes without going considerable distance for it. The reason for this was that the mains instead of passing along the streets upon which the lots abutted, were upon the cross streets, making it necessary for all parties in the middle of the block to run a service at least ½ and sometimes 1½ blocks to get water into their residences. This could just as well have been avoided by running the lines in the system in the other direction, serving the same fire district as well as taking care of the individual property holders. The designer should therefore bear in mind that ultimately the property holder will use city water in their properties and should only be required to go to the abutting street to attach his service to the main. In other words the main should pass along the streets which have the most abutting lots.

Special Castings

While we are on the matter of the general layout of the mains it might be well to mention another matter of more than passing note, which is the lack of specials, such as tees, valves, etc. that are installed in most mains. Of course as far as valves are concerned the use of a tapping machine is supposed practically to eliminate the necessity of cutting off the water, but from past experiences of most superintendents and public officials it would appear that one should be put in every block. This might verge upon extravagance, but in any event any line that has a posibility of extension should have a valve placed at the end where work has stopped so that upon con-

(Continued on page 231)

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(Continued from page 229)

tinuation the water in the existing main will not have to be cut off. The matter of the specials is of equal importance with the valves and they should be set in at every intersection regardless of whether there is an apparent need for them at the time or not. This should include tees for hydrants as well as crosses for all cross streets. While on the matter of specials, it might be well to call the attention of all superintendents and other officials to the fact that it is poor policy to set hydrants without a valve in front of them, as they are sure to get out of repair, and if no valve is placed some difficulty will be experienced in fixing them.

Pipe Sizes

The location of the well will determine largely the size and location of the mains on some of the streets, perhaps, but as a rule not less than an 8 in. should be laid from the pump to the elevated tank, if one is required, and not less than a 6 in. within the business district; while in the residence district not less than a 4 in. main should be used. It is true that a number of cities and towns have installed as low as 1¼ in. mains, but at best they are only temporary and in the long run must be removed and replaced by larger pipe, making the final expenditure sometimes as great as would have been necessary to have put in an 8 in. main in the first place. It is therefore advisable under most conditions to have no mains smaller than 4 in. and as much larger as the conditions demand. It is quite customary, and is getting to be general practice, to place the mains not on the centerline of any street but to one side. The side selected depends on conditions, but usually mains are laid on the north side of east and west streets and the west side of north and south streets, at a distance of 23 ft. from the north and west sides of the corresponding streets. Also for the convenience of the firemen as well as affording some better protection from freezing, the northwest corner of the intersection, is selected for the location of all hydrants. The object of keeping on the 23-ft. line is to leave the center of the street for sanitary sewers as well as making a convenient setting for the hydrant.

Pumping Equipment

As to pumping equipment, it would be impossible to make a hard and fast rule as to what is best to use, owing to the wide variation in the demands, but for the average small town, where wells are used, some form of the deep well type of pump meets most often the requirements. However, a study of the exact situation may demand a certain type of pump in one town and a different one in another. It might be well to state at this point that pumps are not always sold on their adaptability for a certain condition in the town.

The pressure for ordinary house use it usually about 40 lbs. in most cases and is supplied by an overhead tank on a tower or stand pipe or by pressure system. The pressure system, in cases of very small towns (of say 300 to 500 people) makes a system that is usable, but is not very dependable in case of large unexpected fires, and in many cases as soon as the town can stand the expense an elevated tank on a tower is put in its stead. The direct pressure system is but seldom used in the smaller cities and towns, the reason for which cannot be discussed in this short article.

Suggestions on Design

The following suggestions are given as a guide to the planning and designing of water works systems for small cities and towns:

1. Make sure of a pure and adequate supply.
2. Make plans to cover all future needs as far as possible. In other words, so lay out the system that it can be extended in any possible direction.
3. Lay out mains in such a way as to serve the greatest amount of property holders, without their having to go farther than the abutting street.
4. Make extensions in conformity with the original plans, as far as practicable, bearing in mind that all cities and towns have a tendency to increase in size.
5. Be sure to insert sufficient tee's, crosses and other specials, at each and every intersection.
6. Make a practice of laying the main on a certain side of all streets preferably 23 ft. south of the north line of all east and west streets, and 23 ft. east of the west line of all north and south streets.
7. Select a certain corner of all intersections for the location of the hydrants, as far as possible, preferably the northwest corner.
8. Make a practice of putting in a gate valve in front of all the hydrants.
9. Choose a pump that is adapted to your needs.

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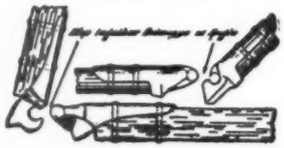

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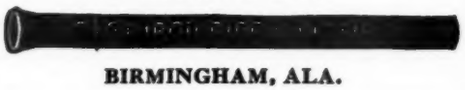

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Municipal and County Engineering

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CONSTRUCTION NEWS AND EQUIPMENT

IN OPENING UP GRAVEL PITS CITIES AND COUNTIES SHOULD ADOPT METHODS SUCCESSFULLY EMPLOYED BY COMMERCIAL PRODUCERS

From now on the limiting factor in many highway construction and street paving operations will be the supply of materials. Several factors influence the material supply, including car supply, labor and the number of sources supplying the raw, road-making materials.

Some states that now have large road-building programs had scarcely constructed a modern highway until a year or so ago and consequently there has been no inducement for anybody to enter the business of producing road making aggregate in those states. In other states the existing commercial sand and gravel plants are generaly adequate for the territory they serve, but they are

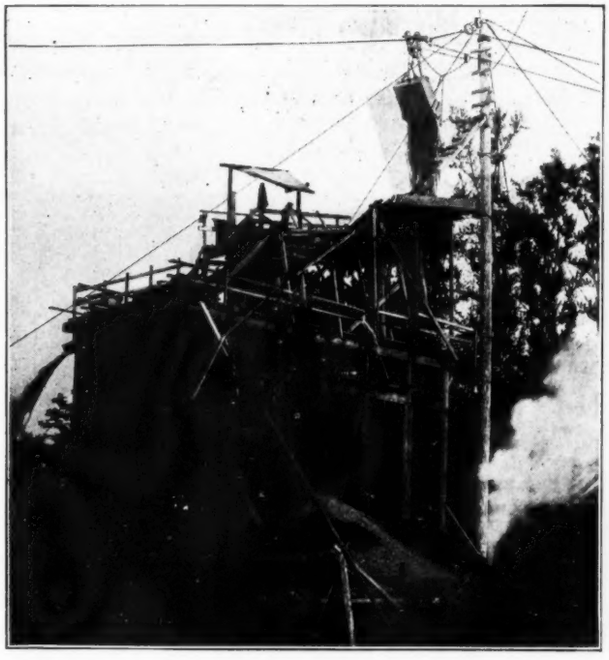

FIG. 1—DRAGLINE CABLEWAY BUCKET DUMPING MATERIAL INTO HOPPER OF CONTRACTOR'S SCREENING AND WASHING PLANT.

handicapped by lack of sufficient open top cars to ship all the materials they can produce, and, furthermore, the demand from the road builders comes all in the space of a few months instead of being spread over a period from March to November as it should be.

It follows that local sources of road-making aggregate will be investigated more and more by contractors and road officials, and many deposits of usable materials, now idle or inadequately worked, will be properly developed.

Do Not Adopt Makeshift Methods.

Of course there will be many ventures by men lacking experience in this field that will come to grief. Opening up a gravel pit and properly equipping and operating it are not simple matters, but contractors, municipalities and counties have made a success of it when they have patterned after the commercial producers instead of adopting makeshift methods.

It is generally recognized in the sand and gravel field

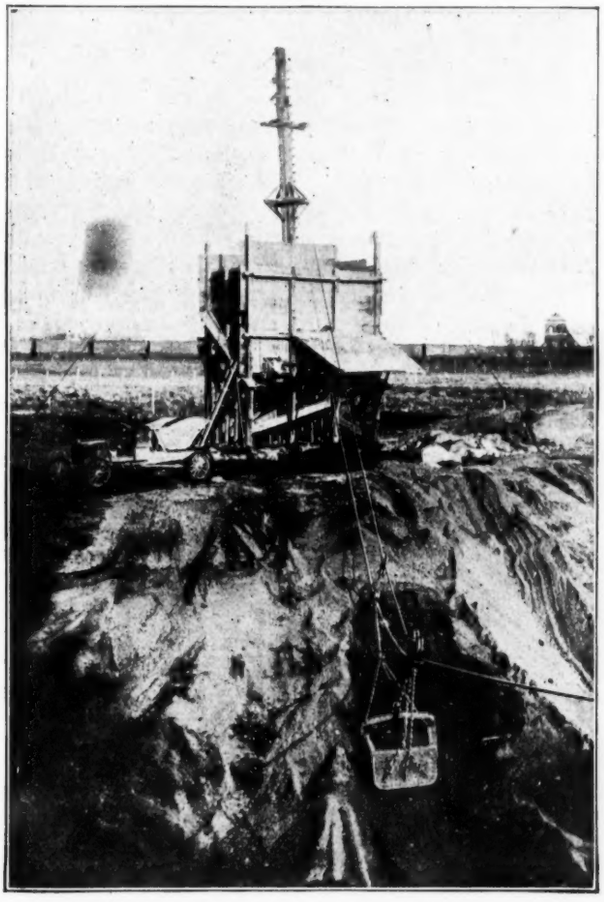

FIG. 2—WORKING A LOCAL PIT WITH SAUERMAN DRAGLINE CABLEWAY IA CONNECTION WITH PAVING JOB.

that for small and medium-sized plants, that is, plants producing from 100 to 1,000 tons per day, the dragline cableway excavator offers the best method of excavating and handling the materials. This type of equipment, operated by one man, will dig and carry materials over a long span in one movement without the help of auxiliary conveying equipment and will work under water as efficiently as in the dry pit.

It is apparent that the operation and upkeep of equipment of this type is not expensive, and this low overhead cost particularly recommends it to highway boards and contractors when they are compelled, through lack of a nearby commercial gravel producer, to develop their own

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source of supply. In the state of Washington, for example, where commercial gravel plants are few and far apart, at least a dozen dragline cableway excavators have already been installed this season by contractors who are producing their own materials for road jobs of from 4 to 15 miles long, and one Washington county is operating four of these outfits to supply aggregate for the county highway and bridge work.

County Plants in State of Washington.

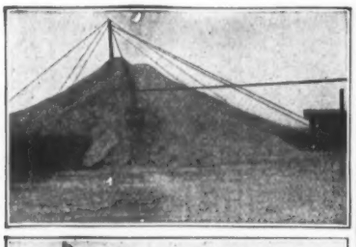
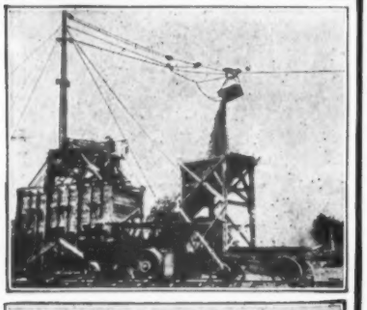
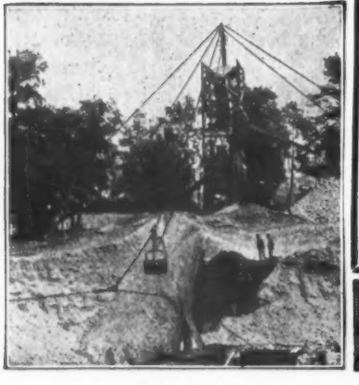
These Washington plants vary in size according to the requirements of the individual contractor, the smallest installation being one for excavating 80 cu. yds. of river gravel per day for re-graveling a county road. A very efficient plant is being operated by Ledingham & Cooper of Bellingham, Wash., to furnish aggregate for their concrete road job near Acme, Wash. They located a fine deposit of gravel in the bed of a river close to the road and about midway along the job. Here they installed the complete screening and washing plant with a 500-ft. span, ¾ cu. yd. Sauerman Dragline Cableway Excavator illustrated in Fig. 1. This size of dragline cableway excavator is capable of excavating and delivering to the screens about 250 cu. yds. in 8 hours, but by working two shifts, the Ledingham & Cooper plant has turned out 500 cu. yds. of washed and screened material per day when it became desirable to push the concreting on a faster schedule than was originally planned. Seven 4-ton motor trucks, also operated in two shifts from 7 a. m. until midnight, haul the sand and gravel from the plant to the mixers.

Contractor's Installation at Estherville, Ia.

A type of dragline cableway gravel outfit adapted to temporary use is that installed at Estherville, Ia., by the Des Moines Asphalt Paving Co., shown in Fig. 2. In making their advance plans for maintaining a fast schedule on a large paving job at Estherville, this contracting firm found that difficulties in getting gravel shipped into the town might interfere at any time with the progress of laying the concrete paving base. Accordingly they took over a partly worked municipal pit and put in a 300-ft. span, ½ cu. yd. dragline cableway excavator with small bin for loading motor trucks, which gives them a dependable supply of 200 cu. yds. of aggregate per day at a low cost per yard. The dragline cableway excavates, conveys and dumps the material onto a grizzly bar on top of the bin structure. Screening is unnecessary, as the material, except for a few boulders which the grizzly rejects, is uniform in composition and suitable in its neutral state for concrete base. The aggregate is handled from the bin direct to the charging skip of the mixer several miles away by using light trucks equipped with Lee end dump bodies. Each truck carries 1 cu. yd. of sand and gravel and three bags of cement per trip. With the haul averaging about 6 miles round trip, seven of these light trucks keep the mixer constantly supplied with materials.

A Michigan Township Installation.

Township and county road commissions sometimes face a situation much similar to that which confronted the Des Moines Asphalt Paving Co. at Estherville, and

SAUERMAN
DRAGLINE CABLEWAY EXCAVATORS

Solving Your Gravel-Handling Problem

It is not so difficult to decide what type of equipment is best adapted to your particular sand and gravel proposition if you will bear a few points in mind.

Just remember that a Sauerman Dragline Cableway Excavator will dig over long spans and to any depth, enabling it in most cases to handle the gravel from pit to plant direct without the help of auxiliary conveying equipment.

Remember also that a Sauerman Dragline Cableway Excavator is especially economical and efficient for digging sand and gravel from under water, as witness its frequent use instead of a pump or dredge.

For a specific recommendation on equipment suitable for your operations, write us in detail about your ground conditions, daily output wanted and other requirements of your proposition and we will give you our frank advice.

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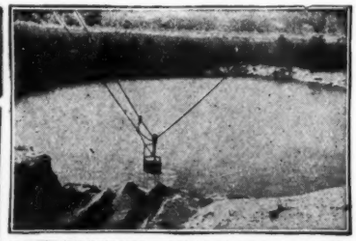
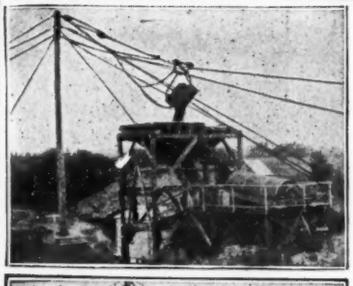
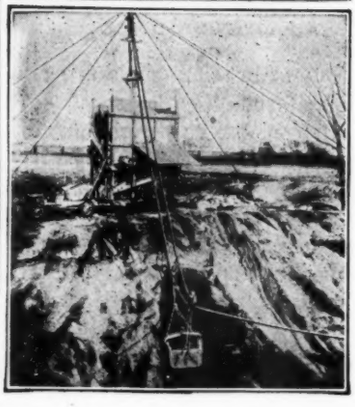
dig convey elevate & dump in one continuous movement under complete control of one man

P & H Excavator-Crane Excavating a Ditch and Grading a Road.

Road Builders' Combination Machine for Excavating, Grading, Backfilling and Material Handling

The P & H Excavator-Crane is a successful answer to the problem long recognized by contractors and manufacturers of producing one piece of equipment capable of performing the four general functions of Excavating, Grading, Backfilling and Material Handling. The four major uses of this equipment by road builders are as follows:

Grading Roads. Where road beds are low and need "shouldering up," or where fill must be made through water-logged and swampy land, the P & H Excavator-Crane will pull in and heap up the ground much faster and cheaper than will teams and graders.

Making Cuts. The P & H will make cuts in roads at the rate of 300 to 500 yards per day. The average cost seldom exceeds $20.00 for a day's operation. When the excavated material is loaded in wagons, the capacity is reduced only about 10 per cent. For constructing drainage ditches, the P & H is run alongside or center of the completed road, excavating the ditches to the required depth and wasting the dirt on the slope of the road bed or beyond the ditch. On this operation the machine cost is rarely over 8 cents per yard, even when handling wet earth where it is often impossible to work teams.

Excavating Gravel. Capacity (approximate) 300 to 500 yards per day of gravel from the bank into trucks and wagons. The hauling equipment, working with a P & H, is never in the excavated hole as it is with steam shovel or trap loading. The P & H Excavator-Crane has a full circle, non-obstructed swing with an operating radius of 30 feet.

A Complete Portable Locomotive Crane. Equipped with a hook, magnet or other grappling device, the P & H is a complete portable locomotive crane with a lifting capacity of 3,500 pounds at 30-foot radius. Great for cleaning up a yard, placing pipe in trenches, pulling piles, moving the bulky stuff, loading and unloading cars. Remember the P & H has a full circle swing and is entirely self-contained, ready to operate on any spot without propping or stabilizing of any kind; worth its cost for this ability alone.

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Pawling & Harnischfeger Co.

EST. 1884

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"You see them wherever you go, and they go wherever you see them."

P&H — excavators — back-fillers - tampers

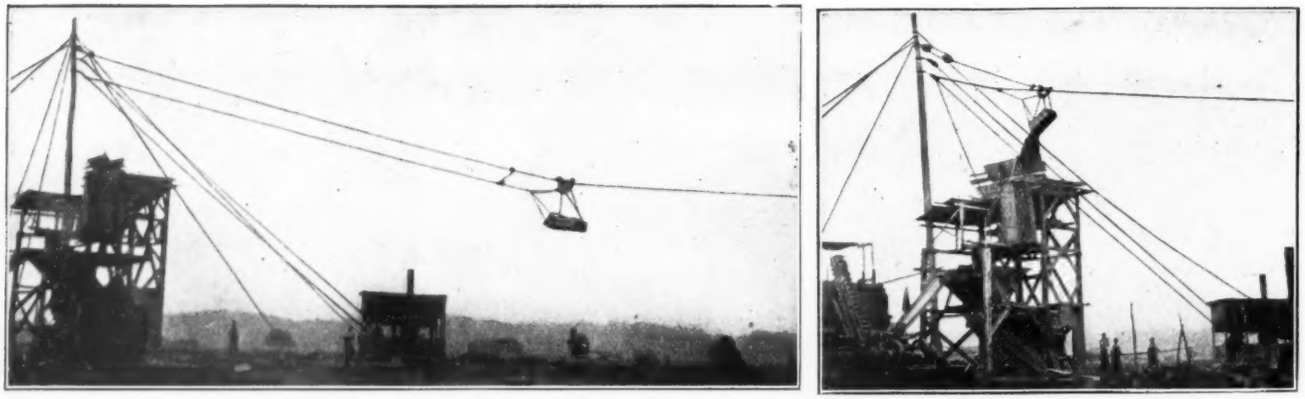


FIG. 3—VIEWS OF SMALL SIZE EQUIPMENT INSTALLED BY ROAD COMMISSIONERS OF A MICHIGAN TOWNSHIP. THIS PLANT PRODUCES SAND AND GRAVEL SUFFICIENT FOR ALL THE TOWNSHIP ROAD WORK.

are able to make profitable use of the smaller dragline cableway excavator outfits. In Fig. 3 is shown the plant which last season produced all the gravel for building and maintaining roads in a certain Michigan township. The township commissioners installed this plant when they found that they were outside the economical shipping radius of the nearest commercial producers. They leased a tract of several acres of gravel and put in a 300-ft. span, 1-3 cu. yd. dragline cableway excavator in connection with which they used a portable bin and screen taken out of an old wagon pit. The bucket delivers the gravel to a hopper, where the over-size material is separated and dropped down to a crusher, to be crushed and re-elevated, while the finer material is chuted direct to the screen over the loading bins. This size of outfit is satisfactory where the amount of material required per day does not exceed 125 cu. yds.

Deposits of gravel are among our most important natural resources and the proper opening up and operation of gravel pits is a study worthy of the attention of all city and county engineers and contractors. However highly developed the art of hard surfaced road construction may become, gravel will always be used, not only as coarse aggregate in concrete, but for the construction of gravel roads.

USING THE STEAM SHOVEL IN ROAD AND STREET WORK

It is a matter of universal opinion that the proposed schedule of highway improvements is the most important program of construction work in the country. Thousands of miles of better roads are to be built; billions of dollars will be spent for materials and labor and a very considerable quantity of new equipment will be required with which to do the work quickly and economically. In every state of the Union highway departments and county road organizations are planning the most extensive improvements that have ever been contemplated. The efficient road builder of today uses machines to do his grading, ditching, sewer trench excavating, and paving. One tool —a good sturdy, reliable steam shovel—will perform any or all of these operations, easier, quicker, better and cheaper than could be done by hand labor. Fig. 1 shows a steam shovel reducing a grade.

It is scarcely saying too much to assert that no other machine has so greatly influenced road grading methods and helped along the movement for the general improvement of our highways systems. With a little Marion, revolving steam shovel, grade reductions have been made practicable, low prices have been filled, dangerous curves and narrow trails have been eliminated, and all at less expense and in shorter time than was ever possible before.

Scarcity of labor lately has been the bugaboo of road contractors and highway boards, but many have found a way out and have built their roads by using the steam shovel for the heavy work and utilizing available labor

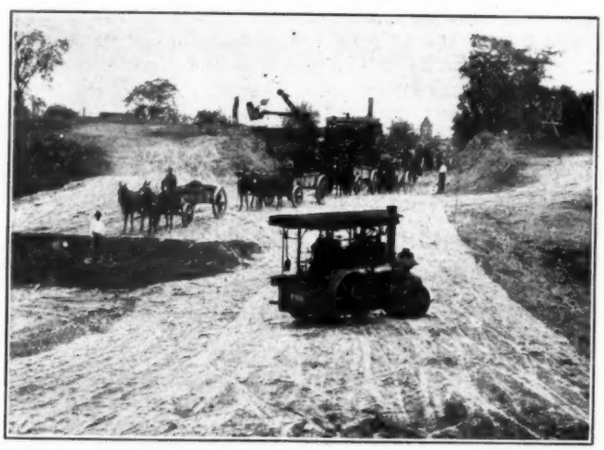


FIG. 1. REDUCING A GRADE WITH A MARION SHOVEL. The Wagons are Kept Loaded and the Shovel Sets the Pace for the Entire Outfit.

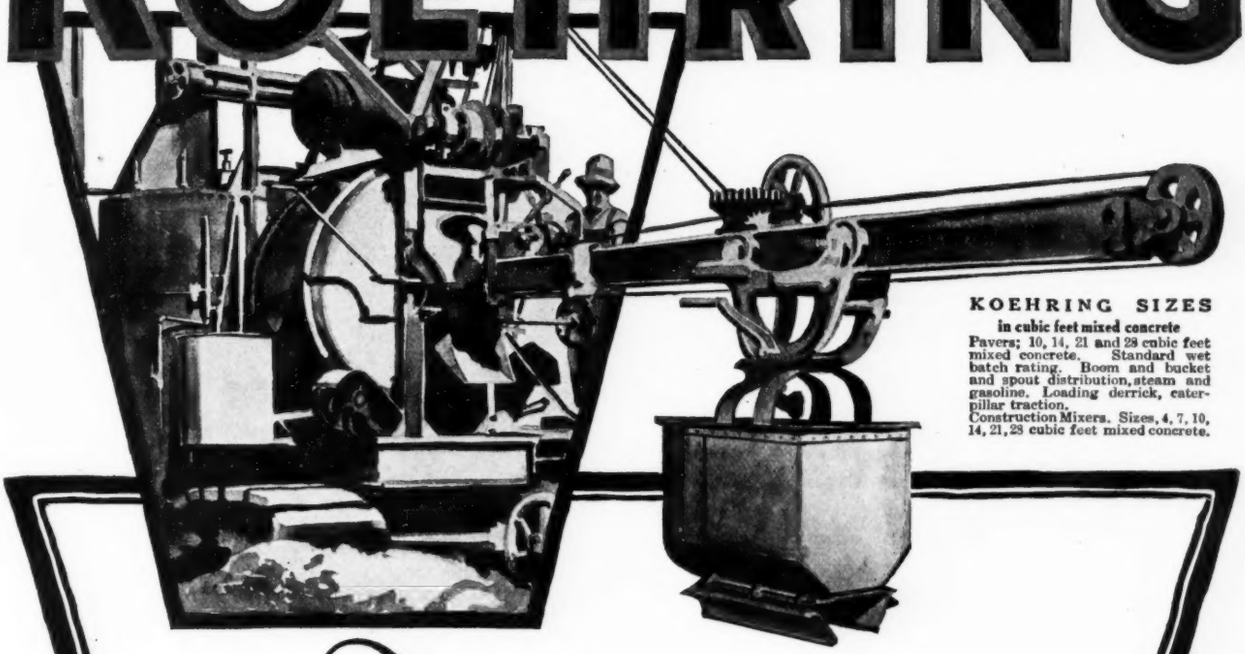
for the small odd jobs that alone needed human labor.

Steam Shovels Are Economical on Shallow Grading

Ten years ago the contractor with a shovel who thought he could profitably do work shallower than 2 or 3 ft. was a general object of mirth; today there are scores of shovels that are making good profits for their owners on street paving work no deeper than 9 ins. As a matter of fact, several cases of 6-in. shovel grading have been reported, and while these are exceptional cases they prove the point that, wherever the amount of work justifies, the small revolving shovel becomes the contractor's "right hand man."

When it comes to excavating sewer trenches, see Fig. 2, it is difficult to get a machine that can do the job better, considering it from all angles. These little shovels will dig almost any kind of material from common top soil to blasted rock and boulders. They will dig in almost any

KOEHRING



KOEHRING SIZES
in cubic feet mixed concrete
Pavers; 10, 14, 21 and 28 cubic feet mixed concrete. Standard wet batch rating. Boom and bucket and spout distribution, steam and gasoline. Loading derrick, caterpillar traction.
Construction Mixers. Sizes, 4, 7, 10, 14, 21, 28 cubic feet mixed concrete.

The fastest Paving Unit

HIGHEST speed operation in charging materials into drum because of high angle charging position of charging skip.

Fastest, easiest controlled discharge because of discharge chute pivoted inside the drum, and arrangement of blades and pick-up buckets.

All these features combined into the fastest paving unit by Koehring exclusive automatic actions which enable operator to maintain day-long, top speed operation—and all supported by the Koehring Heavy Duty Constuction.

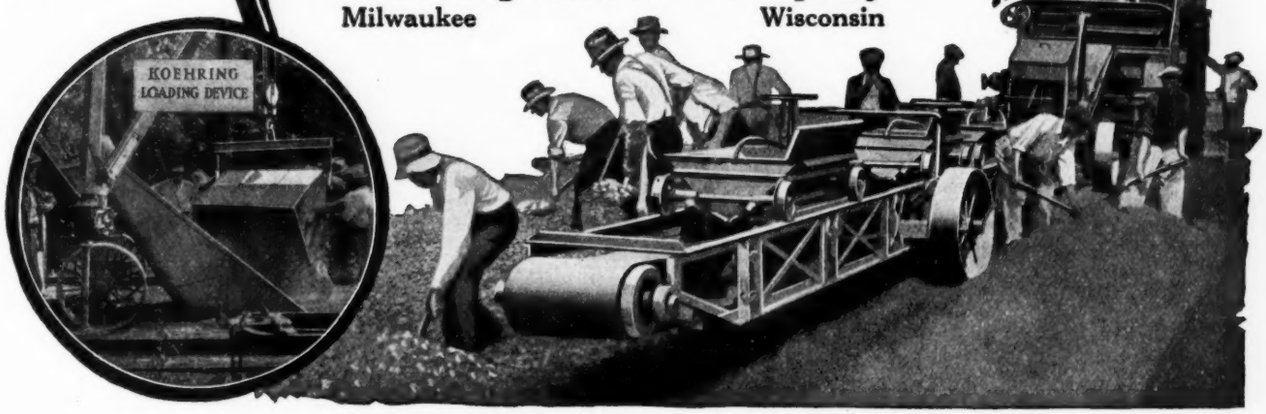
Fastest distribution of any consistency of concrete to sub-grade because of Koehring boom and bucket distributing system, the greatest distributing range without moving the mixer.

Write for Mixer catalogue and Mixer Loader catalogue.

Mechanical Loading

Loading derricks to lift batch boxes from cars or trucks to charging skip. Koehring Mixer Loader when materials are placed on sub-grade cuts out all wheelers.

Koehring Machine Company
Milwaukee **Wisconsin**



length and width, being limited only by the length of boom and dipper handle, and this of course can be varied within a considerable range.

The latest development of the steam shovel is seen in the new "Marion" Model 21, ¾-yd. revolving type, see Fig. 3. This model incorporates features that never before found place in this type of shovel but proved, by practical experience in the hands of users, to be highly desirable. Hoisting engines, 6 x 6 ins. larger than heretofore seen in this type, provide an abundance of power. The boiler is likewise of larger capacity insuring ample steam volume and pressure. Rigid tests must show all Marion boilers able to stand a hydrostatic pressure of 1½ times the allowable pressure. They are most carefully built to conform to all state laws and the A. S. M. E. boiler code. Attention has also been given to the reduction of friction through the use of larger bearing surfaces. All this means increased power at the dipper.

Good steam shovels are usually long-lived, but extra precautions have been taken to make this new "Marion" even more rugged than the former models in this class. All parts subject to extreme wear or strain are made of steel, specially designed and heat-treated. Vital parts are all readily accessible so that inspection and adjustments may be made easily. All bevel propelling gears are manganese steel, a distinct innovation on shovels of this type.

Greater speed in digging and rotating is obtained by reducing the gear ratio and the machine is more easily and more speedily handled by the operator through the use of combination throttle and friction lever. There is

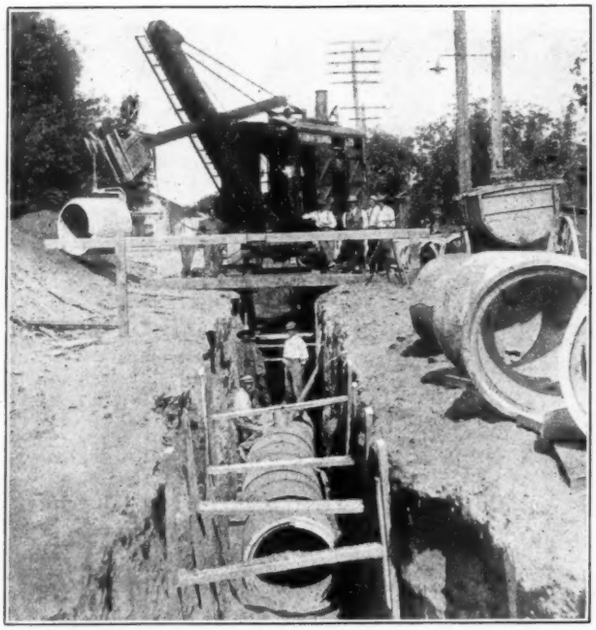


FIG. 2. THIS STEAM SHOVEL HAS DUG THE TRENCH, IS NOW LOWERING THE LARGE PIPE INTO PLACE AND WILL LATER BE USED FOR BACK-FILLING THE TRENCH.

an unobstructed full opening at the top of dipper giving a greater digging angle and increasing the effective pull at the dipper.

The comfort of the operator has also been considered —no negligible feature these days. The house has fold-

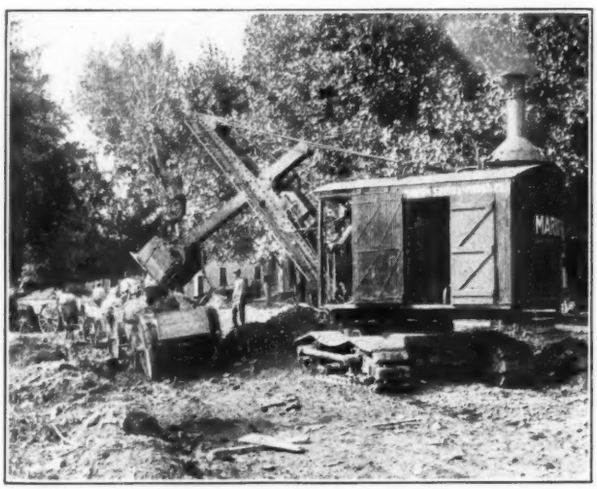
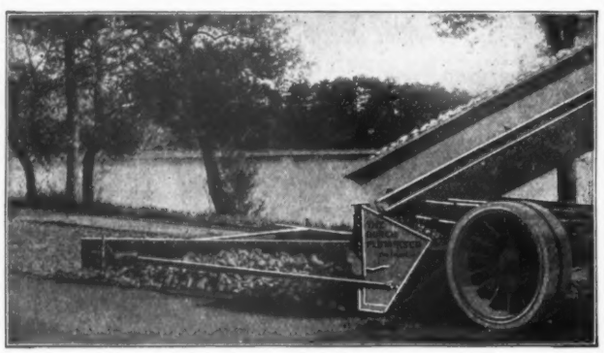


FIG. 3. THE LATEST MARION, MODEL 21, ¾-YD. REVOLVING SHOVEL.
A Practical Machine for Street and Road Grading, Trench Excavating and General Construction.

ing doors that completely enclose it when the shovel is not in use, but the doors may be folded back and the front of the house opened when so desired.



NO MORE MEN NEEDED

The Shortage of Labor Need Not Worry You

Let the other fellow worry about men power and help. Your troubles—at least a good big portion of them—will be over the day you begin to unload and distribute your stone with a **Burch Stone Unloader and Burch Stone Spreader.**

Not only does the **Burch** way do the work with less help, in less time and with less expense, but it prevents loss and waste of material and does a better job than any gang of expert workmen ever did. With a **Burch Stone Unloader** and a **Burch Stone Spreader** in operation, you can positively save the wages of 10 to 12 men.

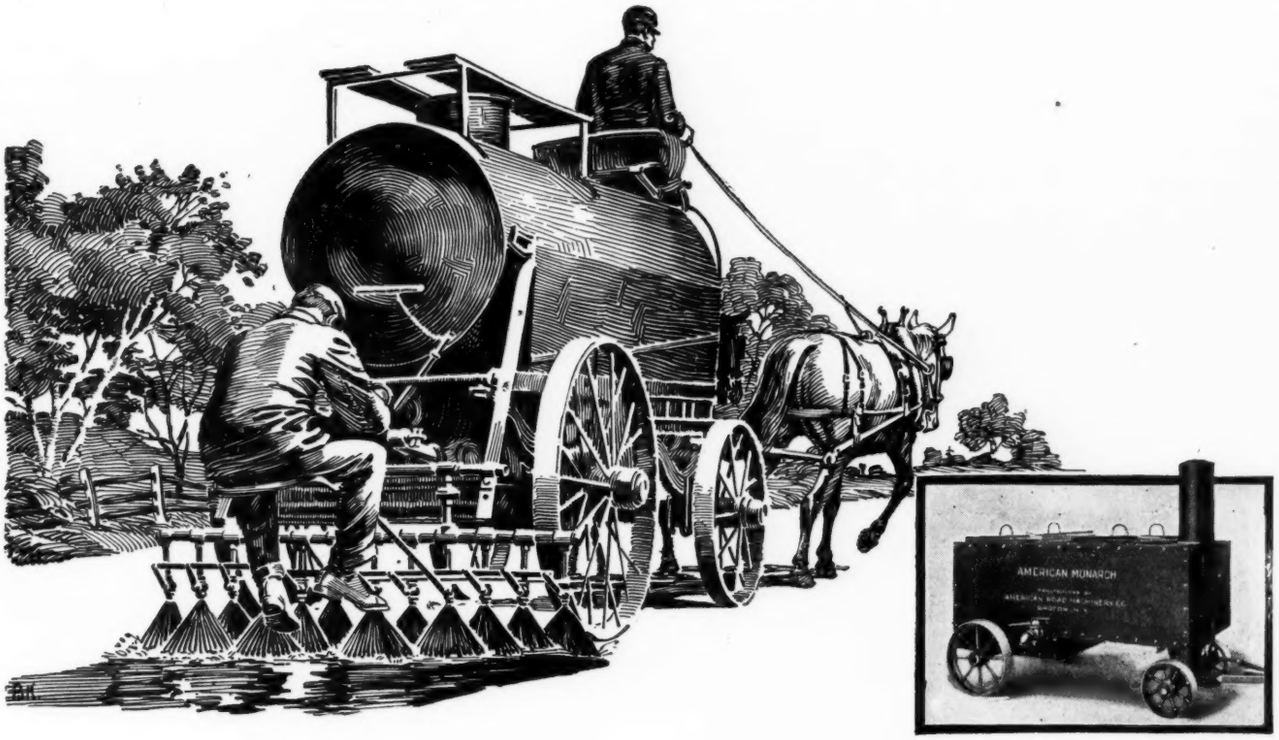
Let us tell you how and why. Write us today for interesting information regarding them and names of successful contractors using them.

The Burch Plow Works Co.

Department W. CRESTLINE, OHIO

TWO MEN DO WORK OF FIFTEEN WITH NEW EXCAVATOR AND LOADER

Machinery that is capable of doing the work that was formerly done by hand labor is saving the day for the contractor. The conditions of the present labor market would probably mean the utter cessation of all building



Road Oiling Machinery

In building roads or applying dust layers and preservatives, the method used is just as important as the selection of the proper materials.

We manufacture road oiling machinery of all kinds, for there is no single machine that will meet every requirement.

Illustrated above is the American Monarch Distributor designed for applying light and medium grade materials under pressure. It has a 600 gallon, sheet steel tank, with asbestos packed riveted joints, equipped with heating and distributing devices and mounted on a platform spring gear truck. We also mount the same tank and distributor on an automobile truck. Insert shows the American Monarch four wheel Heating Kettle.

Our catalog K. E. L. is of particular interest to every builder of roads. We'll gladly send a copy on request.

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The GOOD ROADS Machinery Co., Inc.

"Everything for the Roadmaker"

and construction activities at any other time. Getting and holding a big gang of men has become quite a problem, but newly developed labor-saving machinery has done a wonderful part in meeting this emergency.

An excellent case in point is presented by Contractor Fred Schultz of West Bend, Wis., and his Smith excavator and loader machine. With this machine and but 2 men to operate it Mr. Schultz is able to do the work of from 15 to 18 hand shovelers under ordinary conditions. In addition to the actual saving of workmen effected, the contractor was relieved of the usual anxiety of holding his gang intact.

THE SMITH EXCAVATOR AND LOADER IN OPERATION.

The excavating and loading machine operates on the drag-line principle, that is, the machine is stationed at some spot which affords a convenient drive for the wagons or trucks and the dirt is drawn up to it by a cable. After the material has reached the machine it is lifted up and dumped into the waiting trucks. The illustration shows the principle of operation. Only two men are necessary to operate it; one man at the machine and the other man guiding the digging slip.

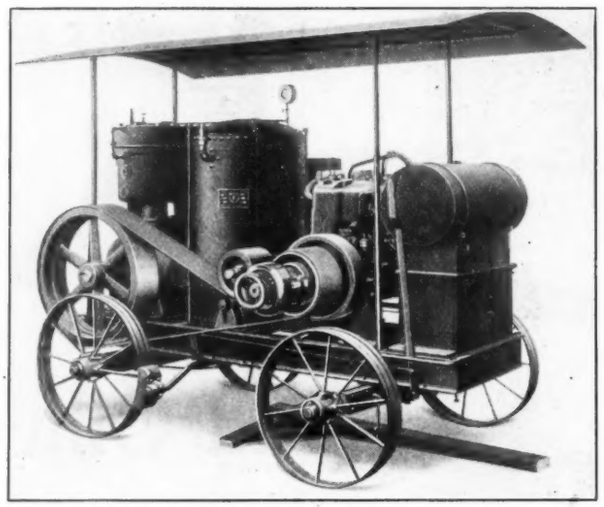
The work done in this particular case is the foundation for the new factory addition to the West Bend Aluminum Works. The material being excavated is wet blue clay, which is being removed at the rate of between 150 and 175 cu. ft. of material per day. This rate is not indicative, however, of the possibilities of the machine, because it was forced to remain idle several minutes between each load to wait for the wagons to carry away the material.

What can be accomplished under ideal conditions was demonstrated by the record established one morning when sufficient teams were available to keep the excavator working constantly. In exactly 3½ hours it excavated and loaded 55 loads, each aggregating 2½ cu. yds., or a total of 143 cu. yds. This is at the rate of over 300 cu. yds. per 8-hour day and shows more clearly just what can be done when the hauling schedule is arranged to keep the excavator and loader busy all of the time.

A PORTABLE AIR COMPRESSOR FOR THE CONTRACTOR

A portable air compressor developed expressly for the contractor has been perfected and placed on the market by the Chicago Pneumatic Tool Co. Each year there is an increasing use of pneumatic tools for road building and construction work necessitating a portable compressor of lighter weight than the Chicago Pneumatic oil or gasoline tank mounted machines, so, in response to the demand, the company has produced this new Class P compressor, here illustrated, to supplement its line of oil and gasoline engine driven portable compressors. The unit is compact and very light in weight.

The air end of this new machine consists of a two-cylinder single acting vertical air compressor having 8-inch diameter by 6-inch stroke, water-cooled cylinders and



THE CHICAGO PNEUMATIC CLASS "P" PORTABLE COMPRESSOR, EXPRESSLY DESIGNED FOR THE CONTRACTOR'S REQUIREMENTS.

plate valves. These valves have been designed for an operating speed of 400 revolutions per minute, and at this speed the capacity is 140 cu. ft. per minute. This compressor being of high speed vertical design combines maximum capacity and minimum weight. It discharges directly into an air receiver having a volume of 10 cu. ft.

The receiver is fastened to the truck by two iron straps placed at right angles to each other over the top of the receiver and bolted to two steel angle sections which form an integral part of the truck.

The power end of the outfit consists of a verticle four-cylinder gasoline engine having 4¾-in. diameter by 5-in. stroke water-jacketed cylinders. This engine operates at 1,000 revolutions per minute, and is fitted with a friction clutch pully of proper size to drive the compressor at its rated speed. The ratio of speed reduction, together with the short belt drive and the use of the idler effectively eliminates belt slippage with its resultant transmission losses and belt troubles. The fuel consumption when operating at full load is 25 pints of gasoline per hour.

Both engine and compressor are thoroughly cooled by a positive system of circulation. The cooling water is forced through the jackets and a high grade efficient radiator by two centrifugal circulating water pumps one driven by a belt from the compressor shaft, the other by gears from the engine shaft. A rapidly revolving fan operating directly behind the radiator draws through it a blast of cool air which extracts the heat. This system of cooling requires but little water and is simple and reliable in operation.

The Michigan Jr. Gravel Screener and Loader

A Machine that will take the Gravel out of the Pit or Pile, Screen out the Sand and Stones and Load the Gravel into Wagons or Trucks.

The machine runs up and down the side of the pit or pile on a track and takes off a slice of about four feet at each time over the track. After going along the track once, the track is moved over and the loader returned along the side of the pit or pile.

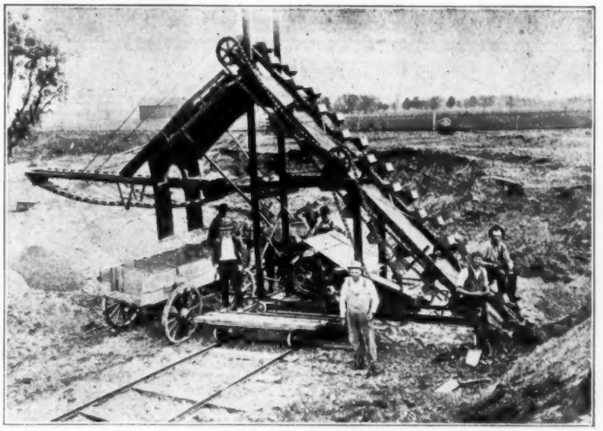
The Screener and Loader is self-contained, furnishing its own power, and has an attachment on the screen that prevents it from clogging up with clay, clods, etc.

The machine has an elevating capacity of *one yard per minute* and, usually, the only operating expense is salary of three men.

One man operates the machine and two men break down the embankment.

The sand and stone are conveyed 20 feet away and do not have to be moved. Machine operates up and down the track as well as in and out of the embankment under its own power. It is all steel, and engine enclosed.

Easily moved from one pit to another. *Saves $30 to $50 per day* in expenses. It is the machine that saves and makes money in handling gravel.



Calhoun County (Michigan) owns and operates four of these machines, and contractors own three others, making seven in the County.

For further particulars write to

THE JORDAN & STEELE MFG. CO., Inc.

CHARLOTTE, MICH.

LITTLEFORD

TAR AND ASPHALT HEATERS

Unexcelled in Road and Street Building

For Contractors' use on construction and larger repair work we recommend the

LITTLEFORD

Portable Tar and Asphalt Heater No. 48

300 to 900 gallons capacity

Reliable, sturdy, long-lasting heaters that are built to withstand the most severe usage. Compact design makes them easy to handle.

Strong
Made of extra heavy plates well riveted. Heavy axles and all steel wheels.

Durable
Proper design and strongest where most wear occurs. Heavy liners in firebox.

Efficient
Kettle entirely within furnace shell and over a large firebox. Heats rapidly.

Write for complete circular

460 E. Pearl Street — LITTLEFORD BROS. — **Cincinnati, Ohio.**

The foregoing equipment is mounted firmly on an all-steel truck having a metal canopy top with canvas sides and ends. The front end of the truck carries a tool compartment and a 20-gal. gasoline tank, the latter mounted high enough to supply the engine with gasoline by gravity at all times. A reliable hand brake is supplied for emergencies.

TRADE NOTE

Mr. M. C. W. Boyd has resigned from active engagement with The Heltzel Steel Form and Iron Co., of Warren, Ohio, as General Manager of Sales. He has not severed his connection with the Heltzel Company, but henceforth will be actively engaged as General Manager and Treasurer of the Good Roads Corporation of Kansas City, Mo., manufacturers of high pressure atomizing road oilers, power flushers and power spreaders of tar and bituminous materials. The factory and general offices of this corporation are at 14th and Chestnut Sts., Kansas City, Mo. Mr. W. J. Savage has been appointed Director of Sales of the Heltzel Steel Form and Iron Co., in charge of the Steel Form Department. Mr. E. V. Ford will be in charge of Parrish Templates and Finishing Machines. Mr. Savage has been with the Heltzel Company for three years, with the exception of one year spent in France in the military service.

CONTRACTS AWARDED

ROADS AND STREETS

Ariz., Tucson—Robert McKay, awarded contract for constructing 11 miles gravel surfaced road from Gunsight toward Tucson, at $66,000.

Ark., Searcy—J. A. Burt, Gunnison, Miss., awarded contract to constr. 17 miles gravel road, White County, at $300,000; 47,045 cu. yds. gravel.

Ark., Springdale—J. H. McIlroy, awarded contract to construct 7 miles Elm Springs Rd., at $170,951.

Cal., Los Angeles—Wm. Liddington, 420 E. 60th St., awarded contr. for impvt. of Lockwood St.—Hoover St. to Virgil Ave.—at $4,525; also contr. doe impvt. of Seaside Ave.—Altoona to Samples Place—at $99,996.

Cal., Redwood City—Hutchinson Co., 44 17th St., Oakland, awarded contract for improving Redwood Highlands Dist., including oiled macadam paving, cement curbing, conc. guttering and grading, at about $54,000.

Cal., Santa Cruz—Marshall & Baker, 2967 Avalon Ave., Berkeley, awarded contract by Bd. Supvrs. Santa Cruz for grading and concrete paving 7.09 miles of road betw. Soquel and Aptos, at $197,861.

Fla., Mayo—Finley Method Co., Heard Bldg., Jacksonville, awarded contract to construct 30 miles hard surface road; $200,000 available.

Fla., Miami—Municipal Constr. Co., McHagee & Sons and J. F. Morgan Constr. Co. awarded contract to pave streets at $121,000.

Ida., Boise—Siems & Carlson, Spokane, awarded contract for grading 8 miles Greer-Fraser Hwy., at $184,008.
Co. awarded contract for paving White Pole Rd. from west end of city to Dallas County line, at $202,736.

Iowa, Rockwell City—Following contracts for graveling Calhoun County Rd., aggregating $150,000, awarded: Snaler Constr. Co., Ackley, Iowa, 30 miles; A. R. Eno, Havelock, and Hammondtreet & Pilmer, Des Moines, 8 miles surfacing.

Kans., Oskaloosa—Hallet Construction Co., Kansas City, awarded contr. for constr. of 10.75 miles monolithic macadam road in Jefferson County, connecting Oskaloosa and Williamston, at $348,115. Some 40 conc. culverts and 2 steel bridges included in contract. Roadway will be 18 ft. wide. Specfs. call for 5½ miles crushed rock, 2½ ins. screenings, finished with oil and asph. surface.

La., New Orleans—Francis C. Constant, Alexandria, awarded contract for 10½ miles of road in Madison Parish, at $133,192; Andrew Hero, contr. for 2.80 miles hwy., Jefferson Parish, at $24,500; Cope & Williams, Orleans, contr. for 3.25 miles rd., St. Bernard Parish, at $13,280.

La., St. Bernard—Cope & Williams, New Orleans, awarded contract by State Hwy. Dept., New Orleans, to construct 3.25 miles road betw. New Orleans and Pointe a la Hache, at $73,280.

Mich., Lansing—J. A. Slatterly, North Branch, awarded contract by State Hwy. Dept., Lansing, for grading, draining, surfacing 6.937 miles State Trunk Line Rd., 38-3, 16 ft. wide, Lapeer and Tuscola counties, at $118,475.

Minn., Brainerd—Ed. Johnson & Co., Superior, Wis., awarded contract for Job 2001, State Rd. No. 2, at $80,563.

Mo., St. Joseph—Metropolitan Paving Co. awarded contract for paving Sparta Rd. betw. St. Joseph and Faucett, at $464,205.

Mont., Livingston—C. T. Heaton Construction Co., city, awarded contract for 6-in. plain concrete pavement, at $414,000. Same company also received large sewer contract.

Nev., Carson City—J. H. Causten, Lovelock, Nev., awarded contract for grading and graveling 27.81 miles state hwy.—Zola to Mill City—Pershing Co., at $94,289.

N. C., Asheville—Asheville Construction Co. awarded contract to surface 8 miles Leicester Road, at $218,000.

N. C., Salisbury—R. M. Hudson Co., Atlanta, Ga., awarded contract to pave 2 miles of streets, at $150,000.

Ohio, Jefferson—T. P. Fitzgerald, 306 Main St., Ashtabula, awarded contr. for grading and paving 6.48 miles Ashtabula-Austinburg Rd., at $171,666.

Mont., Butte—Marco J. Medin & Co., Butte, awarded contract to constr. Butte-Anaconda roadway, 9 miles of paving, solid concrete, 8 inches thick in center and 6 inches at the outer section, at $209,518.

Pa., Harrisburg—R. G. Collins, Jr., New York, awarded contr. for constructing State Hwy., Lycoming Co., at $1,083,057. Road runs through Jackson, Lewis and Coganhouse twps.

Pa., Williamsport—Busch & Stewart, city, awarded contr. for constr. of 29,000 ft. hwy. from Cogan Sta. to Trout Run, at $413,000.

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138 Fulton Street, New York City

The "Heltzel" Heavy Type Road Rail

Guaranteed to Stand Up Under Any Finishing Machine

Highway Departments now specify the bearing surface of rails—to withstand the vibratory action of Finishing Machines. Heltzel Heavy Type Road Rails meet all specifications, and—*they are guaranteed to meet demands.* Rails are made of extra heavy steel, 10 feet long; bottom flange is 4 inches wide, offering 480 square inches bearing surface. Rails will not sink; note the double depending flanges—they mean maximum rigidity, a smooth road surface,

"Ask Any Contractor"

THE PEDESTAL

Rail ends butt together over the pedestal. Lugs and brackets are eliminated. Pedestal supports and anchors rail. It has bearing surface of 70 square inches, and absolutely prevents the rail from sliding.

THE HELTZEL STEEL FORM & IRON CO. - Warren, Ohio

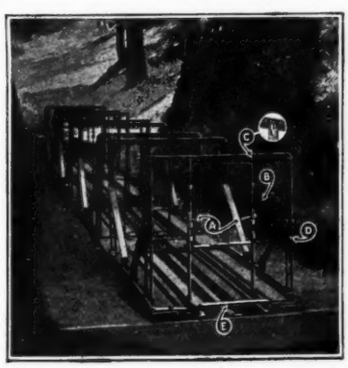
REPRESENTATIVES IN ALL PRINCIPAL CITIES

Contractors, Lumber Culvert Bracing Is Too Costly! Here's a Better Way

JOHN H. GORDON
ALBANY, N. Y.
October 7, 1919.

STORMS MANUFACTURING CO.
Crawfordsville, Ind.

Gentlemen:
I am glad to write this letter recommending your Collapsible Forms for use in constructing culverts on State Highway work. They have given us satisfaction, are all that you claim, and have saved us time and money.
Very truly yours.
JOHN H. GORDON.



Here's a ready culvert bracing that's far better than cutting and building a lumber frame that you can use only a few times and for only one size culvert.

Highway engineers and contractors of a dozen states are building their culverts quicker and cheaper with these **adjustable** and **collapsible** culvert frames.

Think! It takes only about ten minutes (against two or three hours for lumber bracing) to put this

STORMS ONE-MAN
Collapsible Culvert Frame

in place and about the same time to clear the culvert when it is finished. Made of **steel,** adjustable in both height and width to different sizes of culverts. Positively guaranteed not to bulge, buckle or sag. Form lumber is **not nailed** and comes away undamaged when frame is collapsed by a simple pull on the tripping rod.

Why waste high-priced labor and lumber? Write **today** for exact cost data showing the saving of using Storms Frames. Ask for "Bulletin M. E. 1." It's free.

STORMS MFG. CO., CRAWFORDSVILLE, INDIANA

Storms Collapsible-Adjustable Culvert Frames.

R. I., Providence—Jos. D. Aloia, Franklin, Mass., awarded contract for constr. of Putnam Pike, Gloucester, at $93,786; Jos. McCormick, Providence, awarded contract for reconstructing Portsmouth Rd.; waterbound macadam, at $93,804.

Tenn., Nashville—Stephen, Lomax & Schwendiman, Hohenwald, Tenn., awarded contract for State Hwy. No. 1, Lewis and Lawrence cos., at $74,423; Miller & Harle, Morriston, Tenn., contract for constr. of 8.314 miles State Hwy. in Hamblen Co., at $141,087—surfacing with bitum. mcadam; Midcontinent Constr. Co., Nashville, contr. for grading, draing. structures and surfacing bitum. macadam on State Hwy. No. 36; 5.666 miles, at $156,375.

Tex., Childress—Jordan Constr. Co., Plainview ,awarded contract for paving in business district, at $110,000.

W. Va., Fayetteville—Following contracts let by Fayette County Clk.: Grading and bldg. draing. structures on 3.1 miles road, from Deepwater to Robson, involving 49,000 cu. yds. excav., to T. Towles & Co., Princeton, at $64,483; grading and draining 3.1 miles road from Top Paint Crk. Mr. to Loup Creek, involving 46,000 cu. yds. excav., to Walter Sudduth Co., Bluefield, at $44,479; improving 7 miles rd., from Hico to Ansted, involving 40,000 cu. yds. excav. and draing. structures ,to Fayette Constr. Co., Winona, at $56,155; 5.6 miles road, from Prince to Hemlock, involving 60,000 cu. yds. excav. and draing. structures, to G. T. Franklin & Co., Pocahontas, Va., at $80,149.

W. Va., Huntington—C. S. Waugh & Co., Williamson, awarded contract for bldg. brick road from Kenova to Buffalo, at $67,190.

W. Va., Morgantown—Cole Bros. Constr. Co. awarded contract to grade and pave 6.67 miles Fairmont Pike with concrete, 16 ft. wide, at $305,402.

Wis., Delevan — Universal Engineering Co., Eau Claire, awarded contr. for impvt. of Mukwonago Road at approx. $135,641.

Wis., Grand Rapids—Mathis Constr. Co., Grand Rapids, awarded contr. for Grand Rapids-Sherry-Marshfield Rd., Sigel Twp., at total cost of $76,630; also contract for Auburndale-Marshfield Rd. at $72,482.

W. Va., Grantsville—Tulley Constr. Co., Sutton, awarded contract for impvt. of 2.89 miles Arnoldsburg-Spencer Road, 26 ft. wide, at $37,695.

SEWERAGE AND SEWAGE TREATMENT

Cal., El Monte—C. McNeill & Pernal Barnett, 234 S. Center St., Orange, awarded contr. for constr. of sewer system for city, using vitr. clay pipe, at $30,475.

Ct., Stratford (Bridgeport P. O.)—Pierce Mfg. Co., 785 Housatonia Ave., Bridgeport, awarded contract for furnishing labor and material for bldg. 15.6 miles pipe sewer, 8.24 inch in diam., at about $260,000.

Ida., Ashton—R. M. Barsden Co., Rupert, awarded contract for laying 8.15-in. vitr. pipe for trunk line sewer and laterals, at $87,569.

Iowa, Spencer—P. N. Kruse, awarded contract for sewer work at $98,860.

Iowa, Wellsburg—C. M. McEllegott, Evanston, Ill., awarded contract for sewer system here at $52,790; Ward & Weighton, Sioux City, contr. for disposal plant at $16,700.

Mich., Pontiac—C. Johnson, Birmingham, awarded contract for furnishing labor and material for bldg. 14,000 ft. 8 and 10-in. vitr. crock san. sewers; also 8,000 ft. 18-30-in. storm sewers, at $79,046.

Mont., Baker—Two Miracle Constr. Co., Great Falls, awarded contract for constr. of sanitary sewer system, at $110,000.

N. J., Newark—Culp Co., Inc., Paterson, awarded contr. for constr. by branch of Kearney sect., at $159,985.

N. Y., New York—Booth & Flynn, Ltd., 17 Battery Pl., awarded contract for rebldg. sewer in Madison Ave., at $843,297.

N. C., Cherryville—Tucker & Laxton, awarded contract to construct sewer system at $70,000; Dysard Constr. Co., contracts for the disposal plant, which is also included in the cost of $70,000.

Ohio, Akron—R. E. Cooney, 363 Litchfield Road, awarded contract for constructing N. Hill trunk sewer, at $127,000.

Pa., Philadelphia—A. Jafolla, 139 S. 50th St., awarded contract for bldg. brick and concrete sewer in Bigler St., from Delaware River to Severn Street, at about $245,000.

S. D., Kimball—Kircher Bros., Olivia, Minn., awarded contract for sewerage system, at $81,696.

Tenn., Humboldt—Speed & Kearney, Memphis, Tenn., awarded contract to construct sewer system, at $70,000.

Vt., Rutland—Linberg & Street, Old South Bldg., Boston, awarded contr. by Dept. Pub. Wks. for bldg. sewers and paving West and Wales sts., at $77,544.

W. Va, Charleston—W. J. Weakland & Co., Charleston, W. Va., awarded contract for labor and material for following: Upper Glen Gik system of approx. 16,000 lin. ft. sewer; 6th Ave. system of 8,000 lin. ft. sewer; Kentucky Street extension of 1,000 lin ft., at $221,689.

W. Va., Clarksburg—F. L. Grant, Inc., Clarksburg, awarded contract for sewers in Pike, Elk and Main sts., at $100,000; sewers in Ferry and Chestnut sts., at $60,000, to Thoney Pierro Co., Morgantown, W. Va.

Wis., Markesan—F. E. Kaminski, Watertown, awarded contract for digging trenches for water works and sewer systems, at $36,905.

Wis., Milwaukee—Geo. E. Zimmerman, 3102 McKinley Blvd., awarded contr. for constr. of extensions to intercepting sewer system for city, at $258,548.

WATER SUPPLY AND PURIFICATION

Cal., San Fernando—Mercereau Bridge & Constr. Co., 313 Pacific Electric Bldg., Los Angeles, awarded contract for bldg. 3,000,000-gal. conc. lined reservoir, 200 ft. sq., with timber roof, at $24,550.

Ida., Ashton—R. M. Bardson Co., Rupert, Idaho, awarded contract for water works and sewer construction, at $108,514.

Iowa, Washta—Moore-Sieg Co., Waterloo, awarded contract for water works ,at $222,300.

Ky., Versailles—Ansonia Contracting Co., Louisville and Versailles, awarded contract for water works impvts., at $33,916.

Mich., Ferndale (Royal Oak P. O.)—J. A. McDace & Co., 920 Fairview Ave., awarded contract for furnishing labor and materials for laying 25,000 ft. 6-in. cast iron water mains and setting 35 fire hydrants, etc., at about $70,000.

Mo., East Columbus—T. C. Brooks & Sons, Jackson, Mich., awarded contr. for building water mains in various streets, involving 28,000 ft. 6-12-inch cast iron pipe, at $95,500.

N. J., Perth Amboy—Snare & Triest Co., No. 8 W. 40th St., New York City, awarded contract for constructing reservoir, pumping station and pipe line, at $1,095,566.

Pa., Philadelphia—C. H. Dadney, Bellevue Court Bldg., awarded contract for bldg. brick superstruct. for pumping station at Lardner's Point Sta., at about $47,000.

Pa., Philadelphia—E. Fay & Son, 2 S. Mole St., awarded contract for bldg., headwks. and aqueducts; also altering and extending present beds at Queen Lane filters, at about $375,000.

Pa., Philadelphia—R. D. Wood Co. awarded contract for furnishing cast iron pipe and specials in connection with impvt. of Queen Lane water plant, at $210,000.

Tenn., Rogersville—Robert L. Blevins, Bristol, Tenn., awarded contract to install water works. Cost, $75,000 to $100,000.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Anniston—City considering paving Noble Street to 25th Street and 15th Street between Southern trks. and Pine Ave. Engineer's est. of cost, $99,000.

Ark., Little Rock—Eight blocks on W. Markham Street will be paved with concrete at cost of $32,000. Lund & Hill, engrs., have submitted est. on cost of work, which includes curbs, gutters and drainage.

Cal., Los Angeles—Ords. of intentions for street work adopted by City Council: Normandie Ave., conc. gutter 2 ft. wide—39th St. to Santa Barbara Ave.; Evergreen Ave. —1st to 4th Sts.—to be graded and oiled and cement curb, gutter and catch basin with drains to be built; Garnot St., Soto St. to Boyle Ave., and Soto, Atlantic to Opal sts., to be graded and oiled and cement walk, curb and gutter and 22-in. rein. conc. pipe.

Cal., Los Angeles—Ords. for street work passed by City Council as follows: Alley west of Bonnie Brae St., 12th to Pico, to be graded and paved with concrete 5 in. thick; Norton Ave., Wilshire Blvd. to Pico St., to be paved with 5-in. concrete base with 1½-in. Warrenité surface, cement curb, walk, gutter, catch basin, wooden guard rail fence and 49 6-in. clay pipe house connect. sewers to be constructed; Bonnie Brae St., 6th to 7th St., to be graded and paved with bitum. base and Warrenite surf.; cement curb and gutter to be constructed; 1st alley west of New Hampshire Ave., 1st alley south of Pico to point 48 ft. south of 2nd alley south of Pico St., to be graded and paved with concrete.

Cal., San Luis Obispo—Supvrs. have approved plans for hwy. to be built from here to the Cienega roadhouse near Morro, under the $1,500,000 bond issue. Bids will be called for soon. Plans also approved for paved hwy. betw. Santa Margarita and steel bridge over river near Las Militas, and for sect. of rd. at Atascadero.

Fla., Ocala—Marion County Commrs. will construct roads; $560,000 bonds voted.

Ga., Hinesville—$200,000 bonds voted for constr. of hard surface and paved roads in Liberty County.

Ga., Jessup—$200,000 bonds voted in Wayne County for construction of roads. Ira M. Rayburn, Clerk.

Ill., Springfield—Paving impvts. totaling $37,977 authorized by City Commrs. New pavement of brick constr. will extend along 10th St., Ash St. to alley no. of Bryan Mawr in Harvard Park.

Iowa, Cedar Rapids—Resolutions for paving streets and alleys were presented to Council and accepted. Impvts. call for asph. conc. paving on sects. of Camburn Ct., 17th St., 8th Ave., J Ave. West, C Ave. W., Hinckley Ave. and 15th St. Specfs. are for 5-in. conc. base and 2-in. wearing surface. Pavement will be 24 ft. wide except on Hinckley Ave. betw. 15th St. and Highland Drive, where it will be 18 ft. About 5 alleys will be paved with concrete.

Ind., Indianapolis—City plans to pave 2,609 ft. Guilford Ave., 24 ft. wide, $31,923; 1,734 ft. Capitol Ave., 30 ft., $27,716; 1,280 ft. Buckingham Dr., 36 ft. wide, $28,646; 1,059 Spencer Ave., 24 ft., $16,066; grading and paving 3,349 ft. Blue Ridge Rd., 40 ft. wide, $30,324; resurfacing 840 ft. Market St., 50 ft. wide, $16,042; 983 ft. Market St., 41 ft. wide, $15,136; 559 ft. Market St., 50 ft. wide, $10,694; 1,085 ft. Meridian St., 48 ft wide, $19,529; brk. asph., bitum. conc. or wood block. F. C. Lingenfelter, City Engr.

Ind., Logansport—Petition filed for paving Michigan Ave. for entire length, about 15 miles through Cass County. Commrs. have ordered engr. to prepare plans and specfs. for improvement. Engr. Bennett ests. that cost per mile will approximate $45,000, or total of about $675,000.

Kans., Newton—Petitions filed with Bd. County Commrs. for hard surfacing highway in Harvey County under Federal aid act. Petition covers Santa Fe Trail entirely across the county—abt. 40 miles. Road passes through Walton, Newton, Halstead and Burrton.

Mich., Benton Harbor—Resolutions passed providing that City Engr. prepare plans, specfs., etc., for repaving Pipestone, East and West Main, Park, Wall, Colfax and Water streets. Resurfacing of Britain Ave., now almost impassable, also called for from Pipestone to Colfax.

Mich., Grosse Pointe (Detroit P. O.)—Plans being prepared for grading, shaping and paving 1 mile St. Clair Ave., 30 ft. wide, involving 17,600 sq. yds. asph., on 6-in. conc. base. Abt. $85,000. M. L. Brown & Son, 823 Chamber of Com., Detroit, engrs.

Minn., Minneapolis—Expendts. of $250,000 of the $475,000 county road and bridge fund announced in road program drafted by members of Hennepin Co. Board. Widening of Superior Blvd. for first 4 miles from 22 to 30 ft. is largest work contemplated. Cost est. at $50,000.

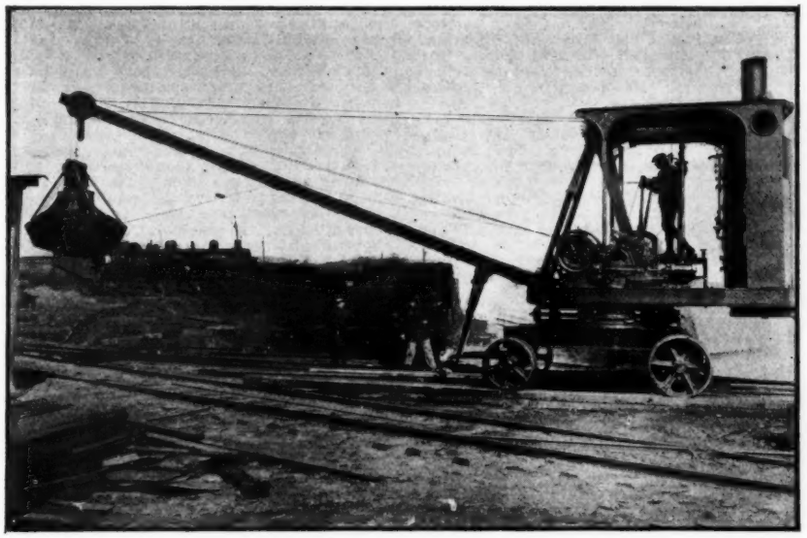
Minn., St. Paul—Ramsey County plans to pave 1.25 miles Long Lake Rd. at cost of $45,000; 1 mile Hudson Rd., from here to Washington, $40,000; 1.25 miles Snelling Ave., $45,000; 5:25, miles White Bear Rd., to Washington County line, $210,000; all 24 ft. wide; conc. R. E. Godfrey, Co. Engr.

Mont., Thompson Falls—County Commrs. have decided to expend the $150,000 county and Fed. money for paving Dixon-Perma, Whitepine and Dog Lake projects.

N. Y., Brooklyn—Board of Est. today authorized following improvements: Paving with asph. and curbing where necessary a section of 12th Ave., at est. cost $12,600; sim. work on sect. of Benson Ave., $16,300; asph. paving on sect. of 49th St., $11,800; asph. paving E. 8th St., $11,900; asph. paving on 19th Ave., $10,400; asph. paving 65th St., $9,700; regulating and grading Bay 37th St., $12,500; grading 21st St., $2,400, and asph. paving on Lott Ave., $4,600.

N. Y., Depew—Village Engineer instructed to prepare ests. of cost of paving 5 streets in village: Depew Blvd., Harlem St., Crane Ave., Sanilac and Muskingon sts.

N. Y., Rome—City Engineers instructed to prepare paving plans for following streets: Henry St., James St. to N. Y. Cent.



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Locomotive Cranes

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MERRIMAN ASPHALT PLANT

Because it will handle more asphaltic material than any other plant, do it better, and at less cost.

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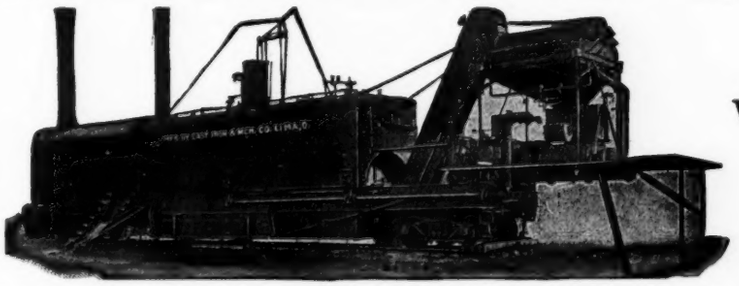

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Steam melting makes it impossible to burn or coke the asphalt. This means a tremendous saving of material—you know what loss burnt batches of asphalt mean.

It also eliminates the possibility of burning the kettle bottoms—another big saving of expense and loss of time when you're busy.

The car measures only 55 feet over all. It is easy to dismantle and set up. Has extra large mixer. Two large melting kettles—a day's run in each. Each unit can be operated separately.

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R. R.; Harrison St., Washington to George sts.; Williams St., Madison to Jay sts.; S. George St., Ridge to Matthew sts.; Henry St., James to Jay sts.; Linden St., Turin to Jay sts.; Fox St., Washington to James; Second.

N. C., Spencer—City will construct asphalt streets; 14,095 lin. ft. asph., 25 ft. wide, at $168,576. R. J. Goode, Mayor.

N. C., Wilson—City will pave streets, extend sewer and water systems; $495,000. Mr. Gladding, City Engr.

Ohio, Cincinnati—City plans to construct boulevard 13 miles long—Westwood to Wooster Pike; also double viaduct in place of present 8th St. viaduct; also reconstruct Glenway Ave. Plans presented to City Planning Comm.

Ohio, Cleveland Heights (Warrensville P. O.)—Village will receive bids this summer for grading, draining, bldg. stone curbing and paving Cedar Rd., Euclid Blvd. to Coventry Road; brick, Medina, granite blk. or asphalt. About $40,000. F. A. Pease Engrg. Co., Marshall Bldg., Cleveland, Engrs.

Ohio, Columbus—Main part of the street improvement work will start abt. July 1st. High St. will be first—Poplar to Buttles Ave.; Fourth, Main and W. Broad sts. are included in program.

Okla., Oklahoma City—$750,000 bonds voted to construct roads in Oklahoma Co. Fed. govt. will appropriate like amt. Engineer not selected.

Ore., Astoria—City plans expendt. of about $600,000 for paving and grading 30 streets and for bldg. sewers in 12 streets. A. S. Tee, City Engineer.

Ore., Baker—County has $59,800 available from market rd. funds and contracts for grading and graveling will be let as soon as plans are completed. Wm. Duby, Co. Judge. County also has $500,000 to match with state funds and local people are awaiting result of May elections, when State will receive authority to proceed with highway plans.

Ore., Bend—City plans to expend $154,518 to improve Division, Hill and Harriman sts.; Greeley, Hawthorne, Irving, Kearnet and Oregon aves. D. H. Peoples, City Recorder.

Ore., La Grande—Union County has voted $1,498,000 highway bonds, which will be used as follows: $400,000 each year, present plans providing for contracts to be let under direction of State Hwy. Comm. Abt. 25 miles grading will soon be let extending from Umatilla Co. line to La Grande. There will also be abt. 6 miles grading from Hot Lake to Union, which will be let as soon as plans are ready. Road from Telo Coscet to Union (9 miles) will be graveled. J. F. Phy, Co. Judge. All the work will be contracted for through the Hwy. Comm. In the Post Rd. funds there is available money for grading from La Grande to Joseph—20 miles. Contracts soon to be let.

Ore., Woodburn—City Council has decided to pave Hayes St., First St. to Settlemier Ave. Paving will be 18 ft. wide. E. Lincoln St., Southern Pacific R. R. to Pacific Hwy.; will be 16 ft. in width. Petition filed by majority of property owners on S. Front St., end of Front St. paving to intersect. of Settlemier Ave., Calling for pavement 16 ft. wide.

Tex., Coleman—Coleman County having plans prepared and will soon call for bids for paving various roads; $1,000,000 bonds voted for project. State and Fed. Govt. will each appropriate $500,000 toward cost.

Vt., Portsmouth—City Mgr. Bates has presented additional paving program to City Council, which will involve expendt. of $159,950.

Wis., Crandon—According to program of highway commission, Forest Co. will expend $57,472 for new roads during 1920. State appropriated $27,472 and Fed. Govt. $30,000.

Wis., Fond du Lac—Resolutions ordering pavements on a number of streets passed by City Commission. City Clerk also directed to advertise for bids on a 2, 3 and 5-ton truck. Truck will be used for general purposes. Streets to be paved are as follows: 15th St., Main to Ellis; Dix St., Amory to Park; Hickory St., Forest to Western Ave.; 11th St., Linden to Park; Ellis St., 8th to 11th; W. Division St., Seymour east to river; 8th St., Ellis to Park. Bids will be asked on rein. cement, asphaltic cement, sheet asph. Comm. also approved figure of Warren bithulithic wearing surf. at $2 a sq. yd.

Wis., S. Superior—Douglas County Bd. of Supvrs. have authorized paving of Union Street with concrete from end of city paving at city limits to Interstate transfer bridge at Oliver; $100,000 bonds will be issued for the work.

SEWERAGE AND SEWAGE TREATMENT

Cal., Anaheim—Election in May to vote on $283,344 bonds for constr. of Anaheim-Fullerton joint outfall sewer to ocean. Cost is est. at $486,031, of which this city's share will be $243,015. Extension of city's sewer sys. to joint outfall will cost $40,328.

Conn., New Haven—City had plans prepared for laying 3,000 ft. 72-in. sewer pipe in Crescent St., Munson St. to Wilmot Creek. About $70,000. F. L. Ford, City Engineer.

Conn., New Haven—City considering constr. of sewer in Chapel St., from West River to Blvd. Abt. $40,000. F. L. Ford, City Engr.

Ida., Rigby—$50,000 bonds voted for purpose of improving sewerage system here.

Ida., Nampa—City plans to build sewers in District No. 26. About $194,000. L. C. Kelsey, Nampa, Engr.

Ill., Geneseo—City Council approves plans whereby Geneseo will be given sewage and drainage facilities. Est. cost, $305,000.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

OF MUNICIPAL AND COUNTY ENGINEERING published monthly at Indianapolis, Indiana, for April 1, 1920.

State of Indiana, County of Marion, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared John H. Pritchard, who, having been duly sworn according to law, deposes and says that he is the Business Manager of MUNICIPAL AND COUNTY ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publishers, editor, managing editor, and business manager are:

Publisher, Engineering Publishing Company, Inc., 702 Wulsin Bldg., Indianapolis, Indiana.

Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Managing Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Business Manager, John H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

2. That the owners are:

Engineering Publishing Company, Inc., 702 Wulsin Building, Indianapolis, Indiana.

Alexander P. Fox, 704 Wulsin Building, Indianapolis, Indiana.

George O. Wildhack, 927 North Meridian Street, Indianapolis, Indiana.

John H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

Edgar J. Buttenheim, Tribune Building, New York City, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:

Alexander P. Fox, 704 Wulsin Bldg., Indianapolis, Indiana.

4. That the two paragraphs next above, giving names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stocks, bonds, or other securities than as so stated by him.

JOHN. H. PRITCHARD.
Business Manager.

Sworn to and subscribed before me this 26th day of March, 1920.
(Seal) WALTER P. HANNA.
(My commission expires April 4, 1920.)

La., Natchitoches—City has voted $240,000 bonds for installing san. sewer system; construct and equip water and light plant; extend water and light lines. W. F. Johnson, Mayor-Commr.

Mich., Ford (Wyandotte P. O.)—City having plans prepared for complete storm water sewerage system, rein. conc. and vitr. pipe. Bonds for $70,000 voted for proj. M. L. Brown C Son, 823 Chamber of Com., Detroit, Engrs.

Minn., Duluth—Council has passed resolutions authorizing bond issue of $300,000 for intersects. in sewers; also bond issue of $150,000 for addns. and impvts. to parks.

Minn., Hanley Falls—E. W. Youngdale, Granite Falls, preparing plans for sewer system; about 14 blocks of tile. R. N. Johnson, Village Clk.

Miss., Tunica—A. L. Dabney, engr. of Memphis, Tenn., has received plans and specfs. for constr. of system of sewers, at $60,000.

N. J., Egg Harbor City—City having plans prepared by Remington & Vosbury, Engrs., 6th and Market sts., Camden, for sewerage system and sewage disposal plant. Est. cost, betw. $40,000 and $50,000.

N. J., Woodbury Heights—City having plans prepared by Remington & Vosbury, engrs., 6th and Market sts., Camden, for sewerage system and sewage disposal plant. Cost betw. $40,000 and $50,000.

N. Y., Hamburg—$200,000 bonds voted to construct sewerage system (10 miles) and sewage disposal plant; include Imhoff tank and sprinkling filters. Hill & Hill, Erie, Pa., Engrs.

N. Y., Rochester—Resolutions adopted by council to construct sewer in Plymouth and Brooks Ave. About $26,000. C. A. Poole, City Engr.

N. Y., Rome—Bd. of Mgrs. State Sch. for Mental Defectives plans to alter sewage disposal plant. Est. cost, $25,000. L. F. Pilcher, Capitol, Albany, State Archt.

Ohio, Kenmore—Plans being prepared for bldg. storm and san. sewers. Abt. $350,000. D. P. Dowling, Kenmore, Engr.

Ohio, Van Wert—City has been ordered by State Dept. of Health to complete modern sewage and drainage plant within two years.

Okla., Beggs—$100,000 bonds voted here for sewers and water mains.

Okla., Wynona—$100,000 bonds voted for construction of sewer system here.

Ore., Joseph—City having plans prepared for bldg. sewerage system. J. H. Lewis, Cham. of Com., Portland, Engr.

Pa., Titusville—Plans prepared for 5,918 ft. sewer in various streets. Cost betw. $56,000 and $60,000. A. Fay, City Engr.

S. C., Anderson—Equinox Mills considering instaling sewer and water supply systems in mill village for 150 homes. J. E. Sirrine, Archt.-Engr., Greenville; Gluck Mills plans to instal sewer and water supply syste mfor 150 houses in mill vilage. J. E. Sirrine, Engr.

S. C., Batesburg—City preparing to install complete sewerage system, extending water mains and pave single streets at expedt. of $132,000.

Tex., Houston—$75,000 appropriated for constr. of sewer on Garret Street.

Tex., Wichita Falls—Election May 20th to vote on $400,000 bonds for sewer system.

Wis., Cedarburg—City has voted in favor of installing sewerage system and water mains. F. G. Schuette, City Clk.; $150,000.

Wyo., Cheyenne—City has authorized bonds in sum of $300,000 for construction of sanitary storm sewers.

Wyo., Rawlins—$45,000 bonds voted for sewer system here.

WATER SUPPLY AND PURIFICATION

Cal., Brea—City trustees considering submitting bond issue of $78,000 for municipal water system.

Cal., Glendale—$100,000 bonds sold for impvts. to municipal water system. City trustees have ordered additional well and 2nd pumping unit at main pumping plant on San Fernando Road; laying of 16-in. main up Grand View Ave. and purch. of additional cast iron pipe for extens. of water surface.

Cal., Long Beach—Mayor Lisenby announces that urgent impvts. to water system will be undertaken at once. City assured of sale of $100,000 worth of bonds by clearing house association. Mayor advocates constr. of conc. pipe line to cost $15,000 connecting Bouton wells with storage reservoir at Anderson Street sta. Well 1,000 ft. deep will be sunk on Barndollar tract. First 150 ft. of well will be protected by 26-in. conc. casing. Est. cost is $12,000; 2 electrically driven pumping plants will be installed later.

Cal., Ontario—$40,000 bonds voted to sink well and install pump.

Cal., San Diego—An 18-in. cement pipe line will be laid in city for distance of 15,000 ft. north of La Jolla. Plans and specfs. being prepared by City Engr. Rhodes, and bids will be called for when Council decides how work is to be supervised.

Cal., So. Pasadena—$325,000 bonds voted for acquisition of Pasadena municipal water works in So. Pasadena, and plant of Marengo Water Co. will be acquired and impvts. and extensions made. New steel and cast iron mains will be laid, 35 fire hydrants will be installed and Marengo reservoir will be lined with concrete.

Cal., Taft—Midway Gas. Co. authorized by State R. R. Comm. to issue $500,000 notes to defray cost of 60-mile addn. to pipe line from Midway fields, in Kern Co., to supply Southern Cal. Gas. Company. Est. cost of pipe, $800,000.

Fla., St. Petersburg—City will call election soon to vote on issuance of $280,000 bonds for improving water plant, $225,000; triple expansion compound condensing pump, 5,000,000 capy. in 24 hours; condenser and vacuum pump; 1,100 cu. ft. air compressor, compound condensing 150 h.p. boiler; 300 h.p. feed-water heater; conc. smokestack; 350,000 conc. ground reservoir; 10,000-gal. fuel oil tank; deepen 5 wells; drill 2 additional 12-in. wells; 300 tons water mains; hydrants; valves; spcls. 116x47 ft. bldg.

Ga., Metter—$35,000 bonds voted for constr. of water works and pumping plant. J. B. McCrary Co., Engr.-Contr., Atlanta, Georgia.

Ga., Swainsboro—$50,000 bonds voted to construct water works.

Ida., Buhl—City contemplates laying 21,000 ft. cast iron mains and repairing conc. lined reservoir. Abt. $125,000. E. J. Baird, Buhl, Engr.

Ida., Soda Springs—Work on the $80,000 water system here will soon begin. City has purchased ranch and with it 4½ cu. ft. water per second from Ledge creek. Large reservoir will be constructed near creek and water piped for 2 miles.

Ind., Orleans—Orange County Public Service Co. incorporated to supply water. Capital, $75,000. G. H. Carter, Director.

Kans., La Cygne—Impvts. to water works system planned, to cost approx. $50,000. Black & Veatch, Engrs., Interstate Bldg., Kansas City, Mo.

Ky., Maysville—Maysville Water Co. has been ordered to install filtration plant, a sedimentation basin and first-class chlorination plant.

La., Pineville—City will construct water works; $55,000 bonds voted recently for this impvt. Wm. Sylvester, Engr., Alexandria, Louisiana.

La., Amite—City Council has appointed committee, with Mayor Geo. Kapfler chrm., to arrange for employment of civil engineer to prepare plans and specfs. for installation of water works and sewerage systems. Vast majority of citizens in favor of the improvements.

Mich., Marquette—Alvord & Burdick, cons. engrs., Chicago, have been retained by city to prepare plans and specfs., arrange and route pipe lines, supervise all drilling and constr work in connection with bldg. of new water plant.

Minn., Virginia—Water and Light Dept. plans to expend $26,000 for extending gas mains, $3,500 for bldg. an oil storage tank, $6,000 for new boilers and other impvts., which will involve total cost of about $125,000. It is also planned to extend water mains to W. Virginia at $24,100 and Parkville at $27,700.

Mo., Jefferson City—State Pub. Serv. Comm. has issued order requiring St. Joseph Water Co. to have prepared plans, specfs. and ests. for complete reconstr. of plant, designed to give adequate service. Water Co. also required to prepare plans and ests. for suitable booster pump plant, designed to give adequate domestic service along Ashland Ave. and Lover's Lane, with fire pressure service depending upon operation of portable booster pumps provided by city. Installation of last named plant is required immediately upon approval of plans and specfs. by Public Serv. Commission.

Mont., Choteau—City plans to construct gravity pipe line for water works system, involving 30,000 lin. ft. 10-in. wood pipe. Abt. $60,000. J. W. Hall, Choteau, Engr.

Mont., Shelby—$37,400 bonds voted by city to improve water works sys.

N. H., Stratford—$70,000 bonds voted to install water works system. Ed. Fuller, Town Clerk.

N. Y., Huntington—Village plans to improve water works system. About $450,000. Johnson & Benham, 150 Nassau St., New York City, Cons. Engrs.

N. Y., Rensselaer—It is planned to supply city with water supply and reservoir which will furnish city with 3,000,000 gals. water a day. Jas. J. Wells, Hydraulic Engr., Rochester.

N. Y., Tonawanda—City contemplates installing 90x190-ft. brk. and rein. conc. filtration plant, conc. flooring. About $200,000. Election soon to vote on bonds for project. T. W. Barrally, Tonawanda, Engr.

N. C., Gastonia—City plans to enlarge and construct water, electric light and power systems; vote on $285,000 bonds.

N. C., Mocksville—City considering constr. of $30,000 plant; install air compressors and force pumps; construct $50,000 conc. 75-ft. towers; 15,000-gal. tank. N. S. Mullican, Engr.

N. D., Hatton—Plans nearing completion for water works system here. Engrs., Atkinson & Hall, Devil's Lake.

Ohio, Springfield—City considering completing 42-in. cast iron supply main to McKaig Park. About $50,000. O. E. Carr, City Mgr.

Ohio, Willoughby—Village has retained M. Knowles, engr., 716 Hippodrome Bldg., Cleveland, to make survey for water works system and reservoir here. About $200,000.

Okla., Beggs—City will construct water and sewer mains; $100,000 bonds voted. For detailed information address Mayor.

Ore., LaGrande—Surveys being made for proposed water system which will cost betw. $500,000 and $1,000,000, depending upon source of supply. Louis Kelsey, Portland engr., employed by city to prepare preliminary estimates and to conduct the surveys. If Looking Glass line is used it will require 40 miles of pipe; 26 miles if Beaver Creek source is selected. Geo. Garret, City Engr.

Tex., Dallas—$400,000 bonds voted by city—Frank W. Woxencraft, Mayor—for improvement of water works.

W. Va., Huntington—Huntington Water Company considering constr. of 20-in. line from 23rd Street to reservoir; $80,000 to $90,000. H. E. Watts, Supt.

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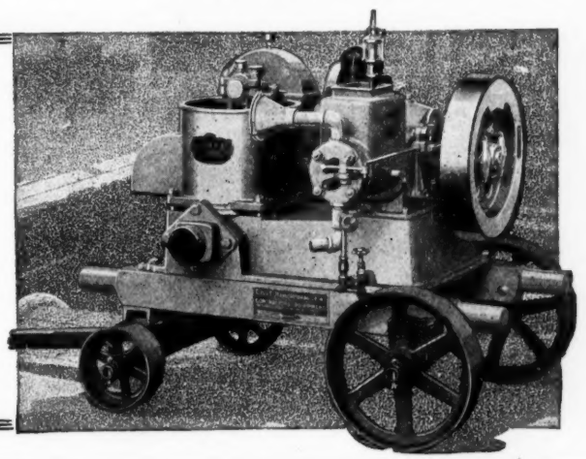

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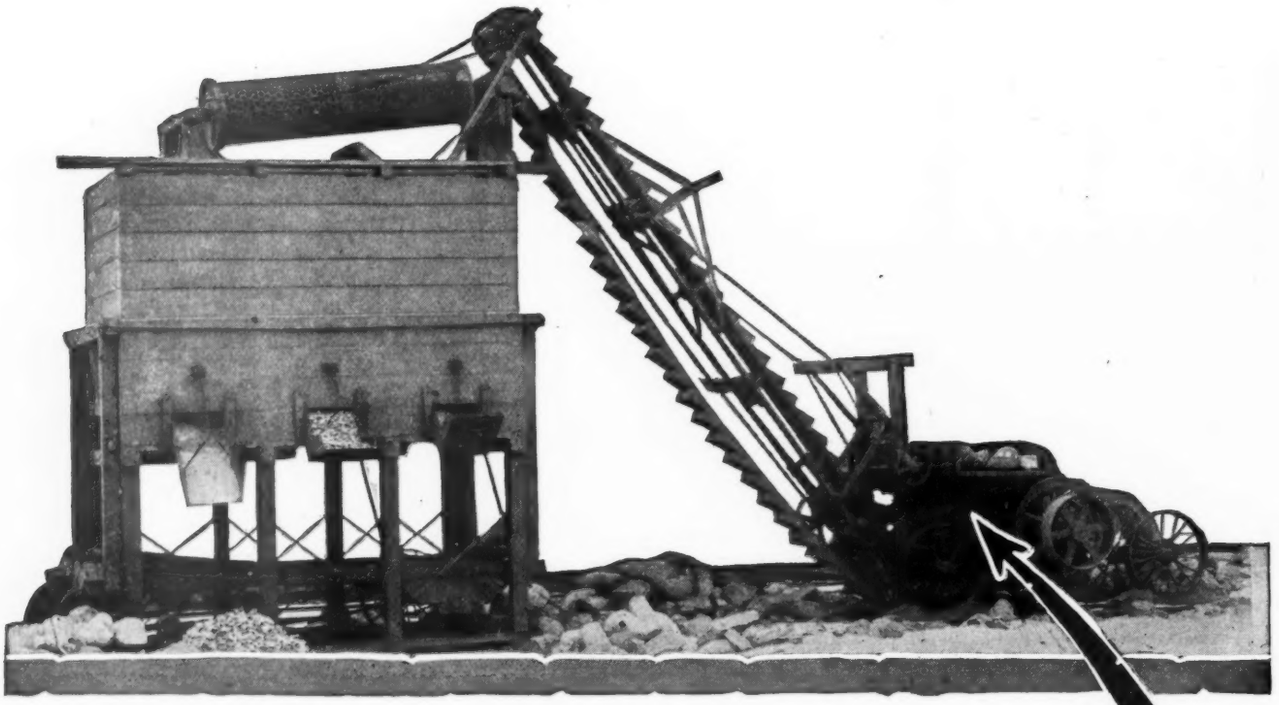

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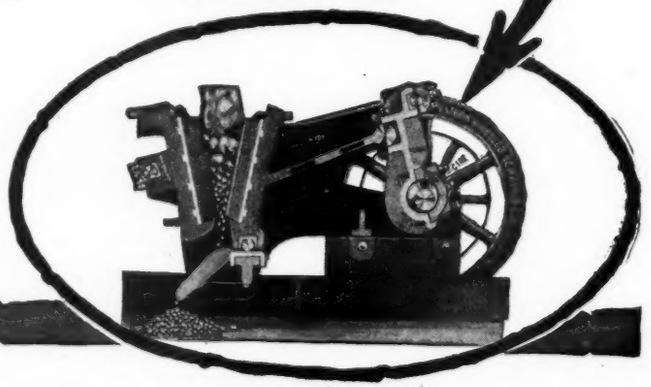

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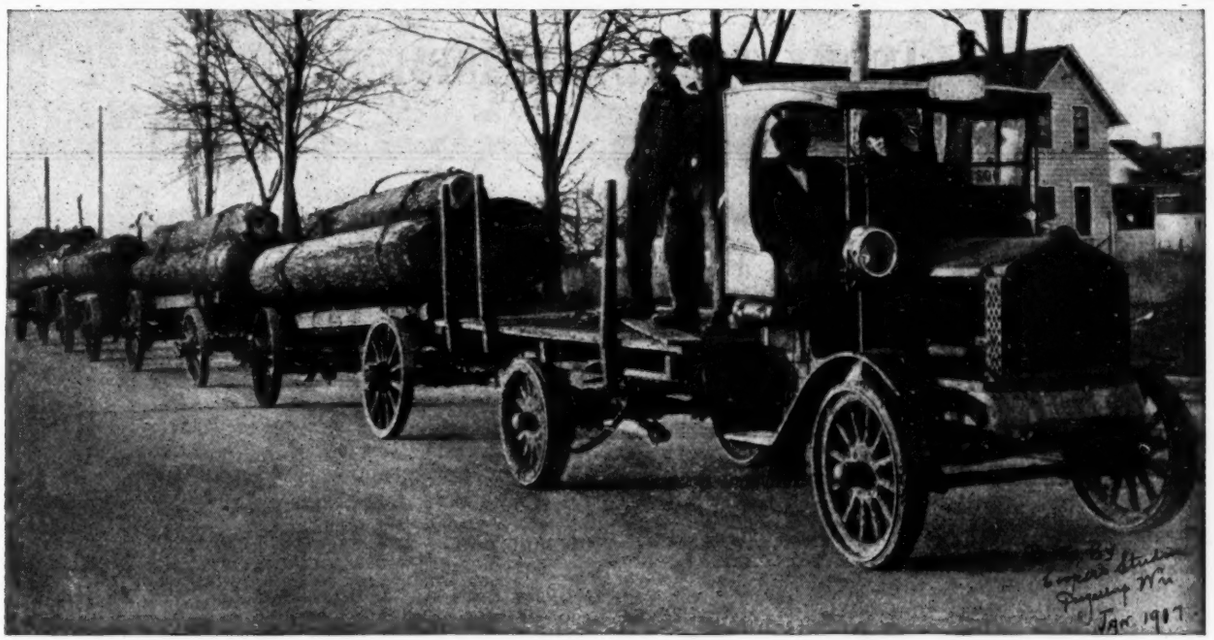

Warrenite-Bitulithic pavement on Stewart Street, Puyallup, Washington, laid in 1910. It has been subjected to traffic of this character for a number of years and does not show the effect of any wear on this account. Picture taken January, 1917.

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